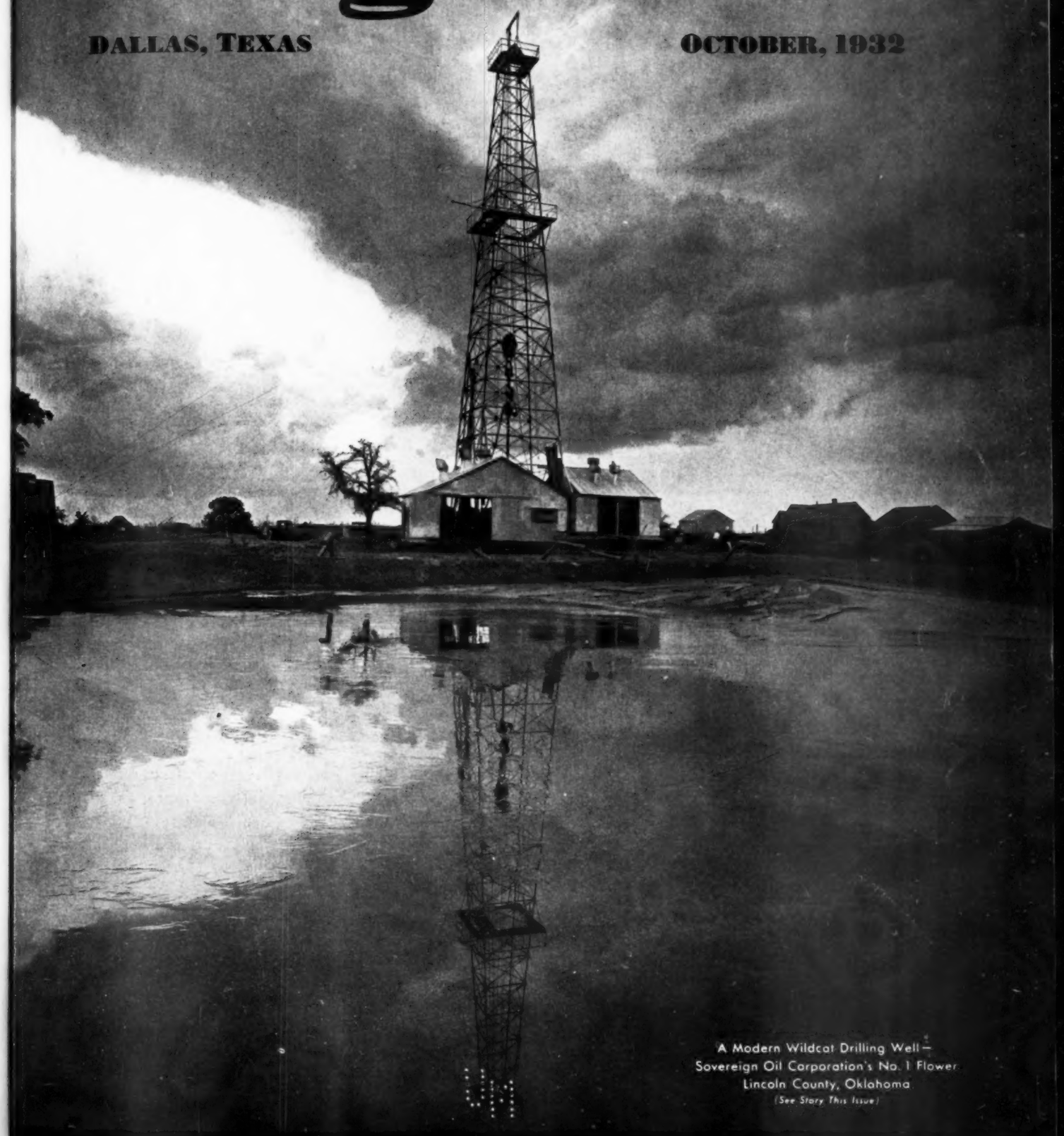
THE Petroleum Engineer

DALLAS, TEXAS OCTOBER, 1932



A Modern Wildcat Drilling Well—
Sovereign Oil Corporation's No. 1 Flower
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(See Story This Issue)

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The Petroleum Engineer

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Here Are Some Facts for You Men Who Want to Reduce Your Operating Costs

Actual results are what count, so we are glad to pass along the information contained in a letter written us under date of August 20, 1932, by George L. Noble, Jr., secretary-treasurer of the Houston Production Company. He wrote as follows:

> *"We have used one of your one-inch 6x19 wire lines on eight wells. We bought this line in August, 1929, and drilled three 3,900-foot holes at Hull, Texas; then drilled four 3,700-foot holes at Kilgore, Texas. We are now finishing a 4,700-foot well at Hull, using the same wire line. We have had excellent service from this wire line and I thought it would be interesting to you to know on just how many holes we have used it. This will be the last well on which this particular wire line will be used."*

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The Month's HIGHLIGHTS in OILDOM

By J. L. DWYER

ACTION was taken during the past month by several states to reduce their crude oil production to a point in line with the seasonal slump in demand, and in others various conservation bodies were initiating moves to further the basis of stability, so as to carry the oil business through the coming winter.

In California, a definite program has been drawn up. It will limit the output of the state for the remainder of the year to 440,000 barrels per day, or less. Steps are now being taken to work out a ratable flow for each flush producing field.

The most startling development of the month in this respect was the action of the Texas Railroad Commission in sharply reducing the amount of allowable oil which may be produced in the Lone Star State. In a broad order affecting all fields, the daily allowable oil production of the state was set at 804,798 barrels, a reduction of 117,000 barrels daily. The great East Texas field, which has been the bone of contention, was reduced 40,000 barrels daily. The order becomes effective October 15, and replaces orders formerly issued which limited various fields to a per well figure.

In addition to East Texas, some of the other fields were reduced as follows: Panhandle, 10,000 barrels; North Texas, 11,000 barrels; West Central Texas, 8,500 barrels; Yates, 10,000 barrels; Winkler, 10,000 barrels; Howard-Glasscock, 9,500 barrels; Ector, 2,300 barrels; Crane-Upton, 4,000 barrels; Darst Creek, 4,000 barrels, and Conroe, 12,500 barrels.

Following the action of the Commission, the Sun Oil Company, through J. Edgar Pew, its vice president, announced that effective October 15 it would increase the price of East Texas crude 12 cents a barrel and the price of Gulf Coast crude would be increased 10 cents a barrel. As this is written (October 11), no other companies have established any price changes.

The new Sun schedule of crude oil prices was met immediately by the Consolidated Oil Corporation on all grades of crude in Oklahoma, Kansas, North Central Texas, and North Texas. At the same time, Philtex Oil Company (subsidiary of the Phillips Petroleum Company) announced that it would meet the new price schedule of the Consolidated in Oklahoma and Kansas.

During the month the Texas Railroad Commission also issued an order on the Conroe field which, while limiting the output of the field to a stipulated amount, is the most elaborate set of regulatory rules which has ever been drawn up. Well spacing, casing setting, gas-oil ratios and straight hole drilling regulations have been established in this field. The order has been heralded by engineers as the most important development in boosting the adoption of modern, efficient producing methods in many months.

The most important new oil strike of the month was in Oklahoma, a state that has been surprisingly free from major developments for a time. A new producing field of apparently important area was opened near Perry. It is not likely to disturb the market as it is on a large community block that will call for little offset drilling, but it will increase the number of wildcat tests in the area between Oklahoma City and Tonkawa fields.

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending September 24, 1932

(Figures in Barrels of 42 Gallons Each)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Total Motor Fuel Stocks	Gas and Fuel Oil Stocks
East Coast	99.1	443,000	69.4	14,356	9,285
Appalachian	95.0	88,000	64.0	1,691	1,008
Ind., Ill., Ky.	97.5	278,000	56.6	6,830	4,299
Okla., Kans., Mo.	88.4	224,000	55.2	4,523	3,189
Inland Texas	72.1	85,000	37.4	1,362	2,079
Texas Gulf	98.2	385,000	70.6	5,147	10,493
Louisiana Gulf	97.3	86,000	60.6	1,475	4,462
No. Louisiana-Ark.	94.6	43,000	50.9	175	580
Rocky Mountain	91.4	31,000	22.3	1,395	516
California	94.6	441,000	50.9	15,374	100,151
Total Sept. 24, 1932	93.6	2,104,000	58.3	52,328	136,062
Total Sept. 17, 1932	93.6	2,058,000	57.0	53,099	135,271

Daily Average Production

(Figures in Barrels)

	Week Ended Sept. 24 1932	Week Ended Aug. 27 1932	Week Ended Sept. 26 1931
Oklahoma	390,400	387,150	264,300
Kansas	100,950	95,250	107,850
Panhandle Texas	46,650	53,650	67,100
North Texas	48,550	49,800	54,100
West Central Texas	23,850	24,700	25,900
West Texas	169,850	172,750	204,850
East Central Texas	53,950	56,800	57,850
East Texas	371,500	327,700	429 250
Southwest Texas	54,750	53,850	57,100
North Louisiana	29,750	29,300	29,200
Arkansas	34,000	34,100	38,100
Coastal Texas	144,000	123,500	123,600
Coastal Louisiana	34,350	32,300	25,300
Eastern (not including Mich.)	95,800	101,000	104,500
Michigan	24,500	22,650	12,100
Wyoming	31,900	33,350	36,650
Montana	7,300	7,450	7,900
Colorado	2,600	2,750	3,950
New Mexico	32,000	31,550	43,150
California	481,900	474,400	500,600
TOTAL	2,178,550	2,114,000	2,193,350

NOTE: Stocks at refineries, except in California district, which includes stocks on finished gasoline and engine distillate at refineries, water terminals and sales distributing stations and amounts in transit thereto.

Two Independents Adopt Humble Payment Program

Olney Oil & Refining Company and Waggoner Refining Company, independent refiners in North Texas, have adopted the Humble Oil & Refining Company plan of paying for 60 per cent of the oil run and storing the remainder for account of the producer.

Oil Merger Plan Approved

Stockholders of the Standard Oil Company (Kansas) voted their approval of the sale and disposition of the properties at Neodesha, Kansas, including a refinery and a 50-mile pipe line, to the Standard Oil Company of Indiana.

Oklahoma Oil Racket Probe Started

The Oklahoma Corporation Commission, meeting on October 10th, aroused by evidences of open "racketeering," held a wide-open hearing on sensational charges of oil stealing, overproduction and bribery, that have rocked the Oklahoma City field proration set-up for some time.

The exact outcome of the evidence introduced at the session is not known at this time.

Japanese Navy to Buy California Crude

Contracts have been awarded by the Japan Imperial Navy to two California oil companies for the delivery of approximately 420,000 barrels of Kettleman Hills high gravity crude oil at a price averaging $1.14 per barrel. Delivery of the six cargoes commenced on October 1st and is scheduled for completion before the end of the year. Union Oil Company of California obtained a contract for 280,000 barrels, while the Standard Oil Company of California received the contract for the remaining 140,000 barrels.

This is the first time California companies have landed so large an order for refinable crude from the Japanese navy. Previously published reports had stated the Japanese would purchase their crude supplies from the Russian Soviet government.

Russian Petroleum Contract Signed in Paris

The Societe Petrofina Française has announced the signing of an agreement for the exclusive supply of Russian crude oil and gasoline in France from 1932 to 1937, inclusive. This agreement applies to an annual tonnage of 500,000 tons of petroleum, and to an important quantity of gasoline, taking into account both consumption and the progressive development of refining in France. The two contracting parties have agreed not to extend the advantages of this contract to any third party without mutual consent.

French requirements next year will be approximately 4,000,000 tons. The Soviets will not supply any oil to France beyond the syndicates and the quantities specified.

Maine Defeats Gas Tax Rate Increase by Huge Vote

Maine voters defeated a proposal to increase the state's gasoline tax rate by a vote of eight to one. The report of the official count places the "no" vote at 195,992 and the "yes" vote at 24,008. In some parts of the state the proposal was defeated by ten to one, and more.

It is encouraging that the outcome represented the second straight defeat of high gasoline taxes by referendum vote in Maine and the fourth consecutive defeat by referendum vote in this country.

Excessive Gasoline Taxation Receiving Attention

Gasoline taxation, increasingly enormous until in many localities it is greater than the wholesale value of the commodity itself, has become a definite and serious threat to the entire petroleum industry, from the retailer to the producer. The tax itself is not the only menace, evasion of the levy constituting just as an acute problem, and is one that is becoming increasingly more profitable as taxes on gasoline are raised. It is estimated that bootleggers of gasoline are conducting a racket costing the United States more than 100 million dollars annually.

Apparently the only path is to reduce gasoline taxes drastically, to such an extent that they will not be over-burdensome to the industry and at the same time will provide any insufficient margin of profit for bootleggers.

At this time in many states, there are organized movements to obtain a reduction in gasoline taxation and it is quickly being speeded up by oil men of the Nation. The movement to have gasoline sales tax made uniform over the country and to have it held to three cents a gallon is gaining favor, the reports from state marketing associations indicate. Although a number of states are seeking higher taxes, seven states report agitation for reduction of the levy on this commodity. The majority of the states seeking lower gasoline taxes are those with high taxation and which have found total collections have sometimes been reduced by excessive rates.

Campaigns against evasion of the gasoline tax in various states have been conducted by committees and oil men in general in coöperation with the American Petroleum Institute.

Directors of the American Petroleum Institute met in Excelsior Springs, Mo., on October 12th, and considered the problem of excessive gasoline taxes and discussed means of protecting the public and the oil industry against gasoline bootlegging and tax evasions.

Cuba Would Trade Oil Monopoly for Payment of Debts

A bill introduced in the Cuban Senate would grant exclusive rights for the sale of petroleum in Cuba to a large oil company for forty years, upon the oil company's payment of the entire Cuban debt, including internal obligations for public works, external debts for foreign loans and the floating debt. The bill furthermore provides that oil companies now operating in Cuba would sell their plants at auction and that there would also be a strict supervision of gasoline prices.

Mississippi Adopts Oil Development Regulations

Mississippi, the newest oil producing state in the Union, now has a set of rules regulating the drilling of wells. The rules issued by the State Oil and Gas Board call for applications for permits to drill, the keeping of well logs, state supervision of casing setting and plugging for abandonment. These rules also specify mechanical requirements for different types of casing in the Jackson gas field and define the powers of the representatives on the Oil and Gas Board.

Texas Oil Investigation Planned

The House of the Texas Legislature has adopted a resolution authorizing appointment of a committee of three members to investigate conditions in the oil industry and inquire into enforcement of the State's oil and gas conservation statutes. It is hoped by the bill's backers that the next session of the legislature will be able to pass constructive legislation that would bolster the conservation statutes as a result of the investigation.

Canadian Fuel Oil Tax Will Not Be Enforced

The tax of a half-cent per gallon on domestic Canadian consumption of fuel oil passed by the Ontario legislature in the spring will not be made operative this coming winter, owing to strong popular feeling against it. In addition, revenues from motor licenses and gasoline tax for eight months of the fiscal year have shown increases which more than offset the loss of the expected revenue from the fuel oil tax.

Danciger Cuts Crude Oil Price in Panhandle

A 20 cents per barrel cut in the price of crude oil produced in the Texas Panhandle district has been made by the Danciger Oil & Refining Company. The company buys about 6000 barrels of oil daily from Gray County. The Danciger price schedule ranges from 56 cents a barrel for 35 gravity crude to 68 cents for 40 gravity as compared with a previous price of 76 cents to 88 cents.

Weak Gasoline Prices Attributed to Uncertain Crude Mart

Amos L. Beaty, President of the American Petroleum Institute, in a prepared statement expressed his belief that current weakness in gasoline prices is due to uncertainty in the crude oil situation and does not necessarily mean that the oil industry is confronted with an era of prices below cost of production. He further stated that if producers of crude oil will courageously face conditions and reduce crude oil production to a proper level with refinery demand a perfectly healthy condition will result.

Murray Threatens Complete Shutdown of Seminole

Governor Murray of Oklahoma, when informed there were rumors that major purchasing companies might lower the present price of crude oil, informed the public that if such steps were taken it "would be easy enough to shut down the Seminole field," where most of the production is held by larger companies.

Going further, he warned all purchasers that "they are going to pay a living price for the crude, not an exorbitant one. I would not join in an exorbitant price and $1.00 oil is but a living price and must be maintained."

East Texas Field Two Years Old; Has Set Many Records

The East Texas field was discovered two years ago, October 3rd, and since that time (up to October 1st) has produced 197,883,725 barrels of oil, while 8200 wells have been completed. These completed wells have spread the producing area over a territory of thirty-eight miles long and more than eight miles wide at its broadest point. All of these figures are records for the United States.

Drilling development at one time reached 800 operations and at the present time amounted to about 470 activities, with little signs of any quick decline.

New Oil Discovery in British Borneo

The British Malayan Petroleum Company, subsidiary of the Royal Dutch Shell group, has discovered a light grade crude oil in a deep test in the State of Brunei, British Borneo. The well is flowing 170 tons daily under a high gas pressure from a depth of 5280 feet. Previous production in the region has been heavy oil encountered in shallow wells, which makes the new light oil strike of considerable importance.

California Allowable Reduced

The allowable for California production for the remainder of the year has been fixed at 440,000 barrels or less per day. This allowable figure is based on actual demands as far as they can be determined and withdrawals from stocks during the winter months are not expected.

Increased Interest in Use of Road Oil

The annual Road Oil Congress held in Tulsa, Okla., October 13th and 14th, showed the growing interest in the use of this commodity as a road building material. Many interesting and instructive papers were read and widely discussed with delegates from various road associations.

At the present time there is a cry for economy in road building, which can be provided for by the use of oiled, oiled-gravel or asphalt-gravel highways that while cheap will still provide good roads. It is believed that oil men, by proper encouragement, can expand the road oil market to take care of hundreds of millions of gallons in place of the tens of millions now being used.

Heretofore, such work has been delayed by the lack of any standardized specifications, but with this work undertaken by the Tulsa Congress it is believed that a recognized standard set of specifications will result, and which will enable oil companies to manufacture large amounts of road materials with the knowledge that they are acceptable universally.

Curtail East Texas Oil Thefts

Shortly after opening of the newly created oil investigation section of the State Railroad Commission office at Tyler, Homer Pierson, chief investigator, stated that 50 per cent of the illegal taking of oil from the East Texas oil field had stopped.

Activities of the investigators have resulted in several arrests.

Sues for Gasoline Tax List

Stating that the state law forbidding publication of gasoline tax figures violates the state constitution and is an aid in tax evasion, C. M. Sutherland, Secretary of the Nebraska Independent Oil Men's Association, has applied for a writ of mandamus to force the State Treasurer to reveal the names of those paying gasoline taxes in the state and the amount of tax paid.

A.P.I. Plans Working Meeting at Houston

Forty working committees of the American Petroleum Institute have been assigned rooms in the Rice Hotel for meetings on Saturday, November 12, and Monday, November 14, in preparation for the annual sessions of the Institute in Houston, November 15, 16 and 17. These committees will discuss various reports that are to be submitted to the annual assembly.

They will consider such topics as waste in all three divisions of the industry, fire prevention, corrosion of equipment, car service and freight classification, production records and nomenclature, railroad and pipe line transportation, testing methods, specifications and standardization, refinery technology, used crankcase oil, well spacing, A.P.I. district activities, fundamental research on occurrence and recovery of oil, and uniform laws.

These forty committees represent only about one-eighth of the more than 300 committees that have been constituted to carry out the program of the Institute in serving the oil industry. A large number of the committees held sessions at the mid-year meeting of the organization in Tulsa early in June.

Latest Activities ith

Figures on maps indicate average prices paid for oil in adjacent fields

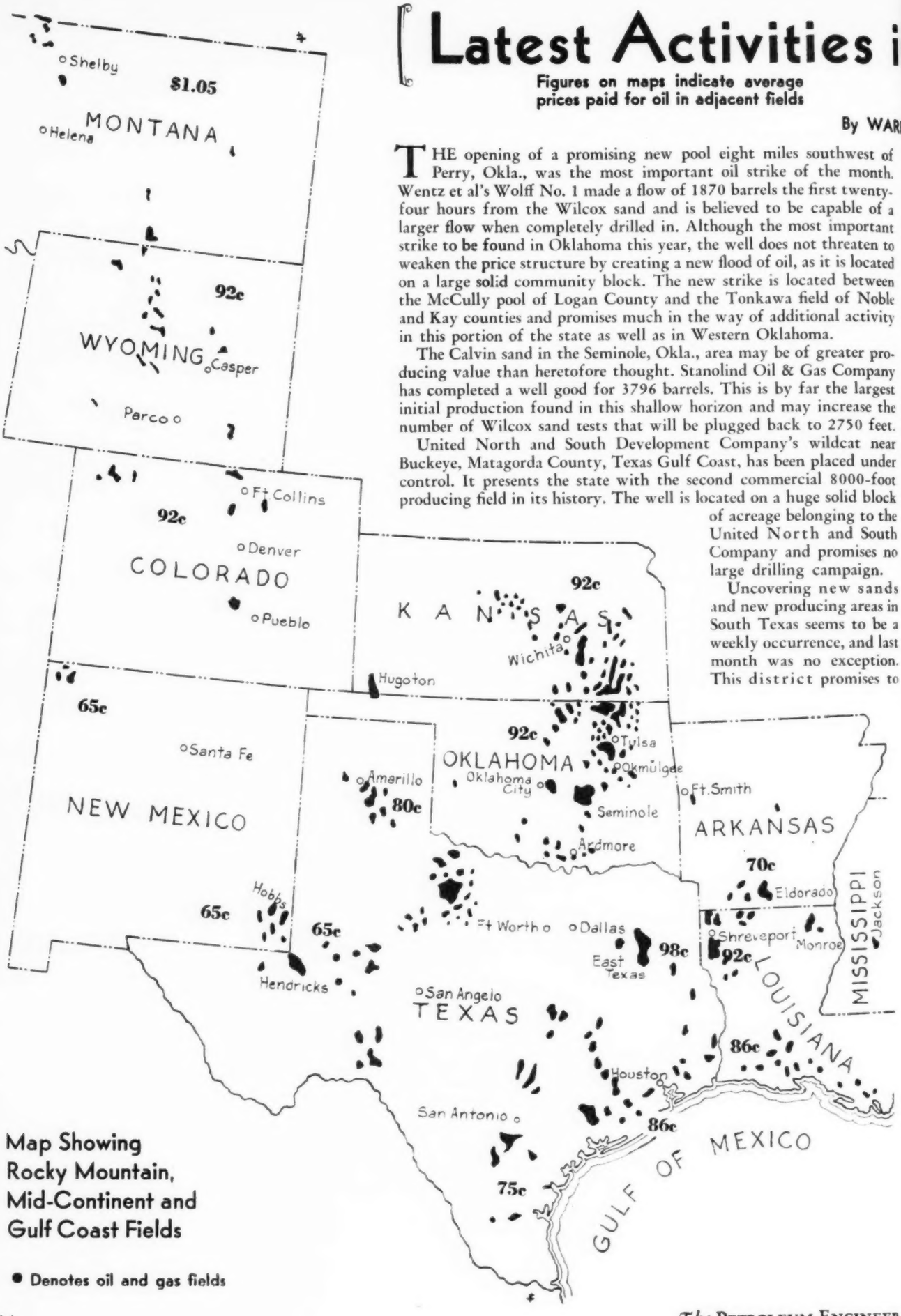
By WARR L. BA

THE opening of a promising new pool eight miles southwest of Perry, Okla., was the most important oil strike of the month. Wentz et al's Wolff No. 1 made a flow of 1870 barrels the first twenty-four hours from the Wilcox sand and is believed to be capable of a larger flow when completely drilled in. Although the most important strike to be found in Oklahoma this year, the well does not threaten to weaken the price structure by creating a new flood of oil, as it is located on a large solid community block. The new strike is located between the McCully pool of Logan County and the Tonkawa field of Noble and Kay counties and promises much in the way of additional activity in this portion of the state as well as in Western Oklahoma.

The Calvin sand in the Seminole, Okla., area may be of greater producing value than heretofore thought. Stanolind Oil & Gas Company has completed a well good for 3796 barrels. This is by far the largest initial production found in this shallow horizon and may increase the number of Wilcox sand tests that will be plugged back to 2750 feet.

United North and South Development Company's wildcat near Buckeye, Matagorda County, Texas Gulf Coast, has been placed under control. It presents the state with the second commercial 8000-foot producing field in its history. The well is located on a huge solid block of acreage belonging to the United North and South Company and promises no large drilling campaign.

Uncovering new sands and new producing areas in South Texas seems to be a weekly occurrence, and last month was no exception. This district promises to



Map Showing Rocky Mountain, Mid-Continent and Gulf Coast Fields

● Denotes oil and gas fields

the Oil Fields

Figures giving production of individual fields will be found on page 15

L. BAKER

show considerable increase in activity as a result of the numerous strikes made in the past three or four months. Most of the wells have found comparatively shallow producing horizons and have been only of normal capacity, but when they are all combined they make quite an imposing combination. A discouragement in the district during the past month was John O'Neill's test just east of the Tuleta field discovery well, Bee County. This test failed to find the production expected and casts an unfavorable light on the new pool's future.

The finding of salt water in two important wildcats in East Texas cleared the slate of promising discoveries in this region. Many blocks are to be drilled, however, and these will continue to offer threats of new Woodbine production.

In Kansas, forty-eight wells in the scattered pools of Central West Kansas, known as the Ellsworth-Barton Arch district, have a potential of more than 50,000 barrels per day. Operations in the district, which spreads over a tremendous area, are being held up by lack of outlets for oil and due to the spotted condition of the producing formation.

From the standpoint of drilling operations throughout the country, the most important development has been the increase recently shown in wildcat tests. It appears that in a number of regions operators feel themselves in the need of building up additional crude supplies, whether it is for the good of the general market or not, while in other cases drilling obligations are becoming due and operators do not wish to forfeit valuable appearing acreage.

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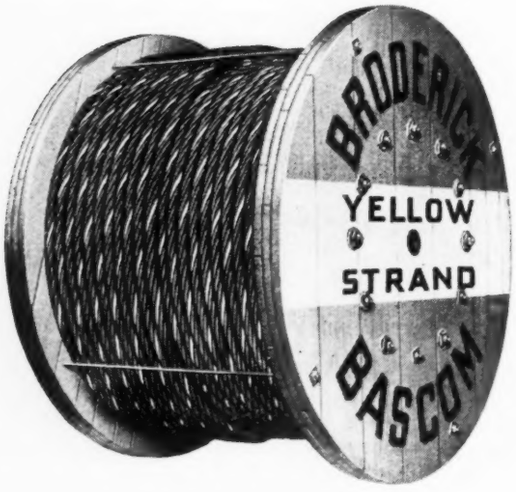

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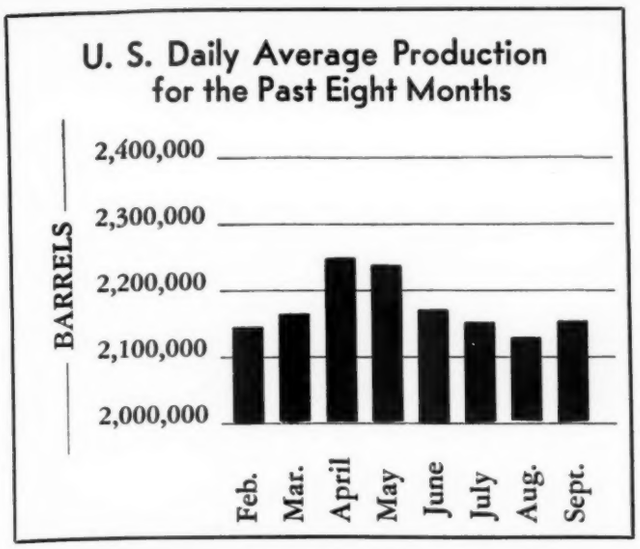
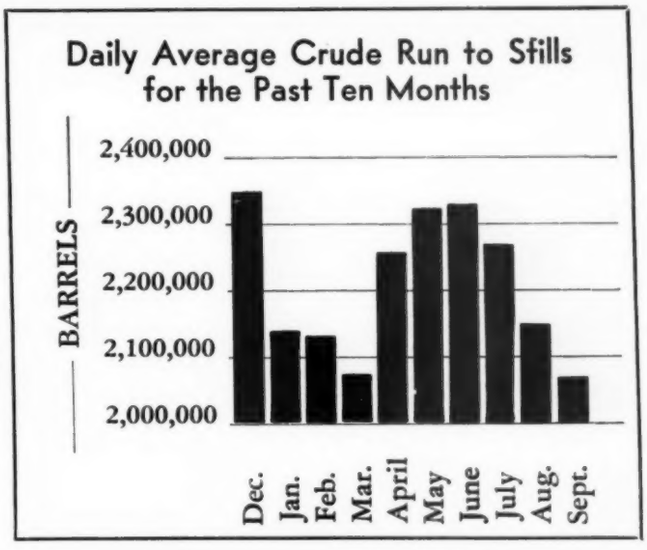
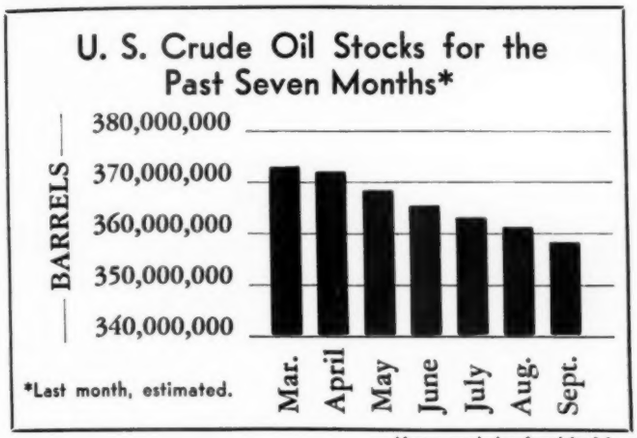
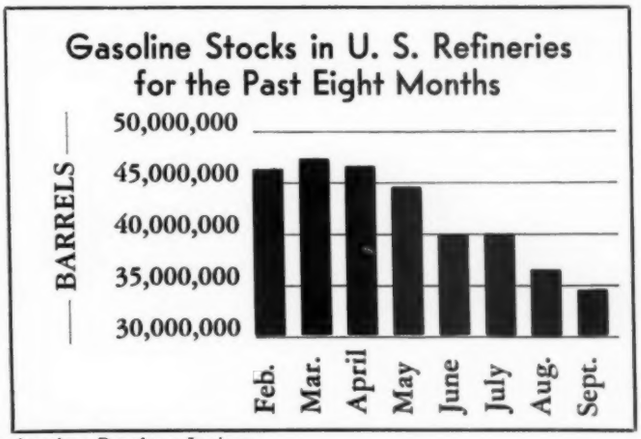
Rotary Drilling Lines









Above statistics furnished by the American Petroleum Institute

Summarized Operations in Active Fields for September, 1932

Fields	Completions	Producers	Locations	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas									
East Texas	462	453	344	162	234	3600	2	40	Rotary
Duval County	28	25	15	11	22	2300	2	22	Rotary
Panhandle	15	13	6	7	37	2900	2	40	Rotary
Conroe	12	10	9	6	26	5200	2	38	Rotary
Oklahoma									
Oklahoma City	14	14	4	19	27	6500	3	39	Rotary
Kansas									
McPherson	12	11	15	12	48	2900-3400	2	38	Rot.-Cab.
Ellsworth Arch	8	5	6	3	29	3300	4	37	Cable
California									
Kettleman Hills	1	1	2	1	12	8300	3 or 4	40	Rotary
Long Beach	4	4	2	1	3	7000	3	26	Rotary

Field Activities by States for September, 1932

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1931 (in Barrels)
	September	August	September	August	September	August	September	August	September	August	
Arkansas	0	2	0	0	2	3	6	7	27	24	15,425,000
California	23	26	17	22	20	22	12	19	107	109	188,575,000
Colorado	0	0	0	0	2	2	9	8	66	65	1,510,000
Illinois	10	6	2	4	....	....	1	1	16	17	4,850,000
Indiana	18	27	10	14	....	....	4	3	65	62	830,000
Kansas	51	73	36	49	47	69	48	50	120	103	37,950,000
Kentucky	36	62	23	35	....	....	10	12	61	67	6,490,000
Louisiana	48	47	30	16	43	54	40	43	131	88	22,325,000
Michigan	32	37	20	26	18	....	38	40	64	66	3,730,000
Mississippi	3	6	1	4	1	....	1	2	14	14	Gas Prod.
Montana	2	6	1	3	12	1	9	9	48	35	2,855,000
New Mexico	10	6	9	4	10	....	7	6	52	50	15,250,000
New York	7	19	7	17	....	....	4	3	11	15	3,400,000
Ohio	68	69	37	51	....	....	31	31	121	109	5,315,000
Oklahoma	100	124	60	92	92	134	129	120	276	302	177,750,000
Penn-sylvania	81	120	79	97	....	....	20	21	84	85	11,225,000
Tennessee	0	0	0	0	....	....	0	0	13	13	8,000
Texas	711	1025	592	861	531	999	319	401	885	879	330,720,000
West Virginia	21	15	19	13	....	....	15	20	41	40	4,480,000
Wyoming	2	5	0	4	1	....	13	14	69	68	14,725,000
Total	1223	1675	934	1315	789	1285	715	810	2255	2195	847,413,000

Progress of Major Pipe Line Work

By J. H. DAMERON

PRACTICALLY all pipe line companies engaged in reconditioning work and the construction of short lateral lines during the past several months have either brought their work to completion or are in the final stages of construction and repair. Little new work is in progress at this stage of the year but considerable activity is found in the northern half of the United States among gas companies or operators in an effort to bring natural gas to communities in that general section.

Southern Union Gas Company, Dallas, Texas, is well along with its construction program for the building of a 25-mile six-inch line running from the Ute Dome area in New Mexico and tieing into the company's main line system at Kutz Canyon. O. E. Fredell, Amarillo, Texas, contractor, is laying the line. The carrier is an acetylene welded transmission line.

As much labor as practical is being accomplished by hand. A flurry of labor trouble was experienced when a group of white laborers protested against the employment of Indians residing in that vicinity. The troubles were ironed out when the contractor employed some of the white laborers residing in that vicinity and permitted the Indians to remain working. Most of the protests were voiced by transient laborers. The line is expected to be completed and ready for test about October 25.

Natural Gas Pipe Line Company of America, Chicago, Ill., builders of the combination welded and coupled 24-inch line from Texas Panhandle to Chicago, has completed plans for the construction of 89 miles of eight-inch line to Waterloo, Iowa. Present plans call for the lateral to start at a point near Oskaloosa and traverse the counties of Mahaska, Poweshiek, Tampa and Black Hawk.

The line is designed for a capacity load of 12,000,000 cubic feet daily. Waterloo is at present supplied with manufactured gas and the change over will be made soon after completion of the line. Other communities along the proposed route of the line will be served by the lateral.

Cities Service Gas, Bartlesville, Okla., is planning the construction of a short six-inch line from Reno county in Kansas to tie into the company's main 10-inch system running to Hutchinson and north. Survey for the line has been completed and it is being built to augment the supply for the existing transmission system.

Michigan remains the scene of considerable effort on the part of various individuals and companies desiring to build lines from the Michigan areas to various markets. The most imposing proposal is to build a line from central Michigan to Detroit. At a recent hearing in Detroit sponsors of one of the proposals estimated the gas reserve in central Michigan to be 600 billion cubic feet. More definite is the proposal of Omar P. Steele, Chicago, who plans to lay a 10-mile two-inch line from the Vernon field in Isabella County, Michigan, to Coleman. The promoter's plans have been approved by the Coleman city council and the proposal is to be acted upon during a municipal election next month.

The Laramie, Wyo., Gas Company is reported to be planning to build a short line from Laramie to Dutton Creek. This plan hinges upon the future development of Dutton Creek. Should the area show a sufficient gas reserve the line is to be built soon.

A similar condition exists for Ontario, Ore., where the United Development Company is planning to develop near-by properties for gas. The company has been given a 10-year franchise to distribute gas in Ontario.

In the East the Lycoming Natural Gas Company, builders of the 20-inch line from Tioga field to Syracuse, N. Y., continues to expand its system. The latest addition to the list of towns served by the new line is Penn Yan, N. Y. An agreement was reached to supply gas to New York Central Electric Company, which has the franchise to distribute gas in Penn Yan. The Lycoming Company is reported planning several lateral extensions to its system.

A group of individuals have obtained a franchise to supply gas to Somerset, Ky., and have several months to fulfill their contract. The gas will be obtained from the Clay County field and will be piped through a line running near Somerset, but which at present is not in service. A new line will be projected into Somerset.

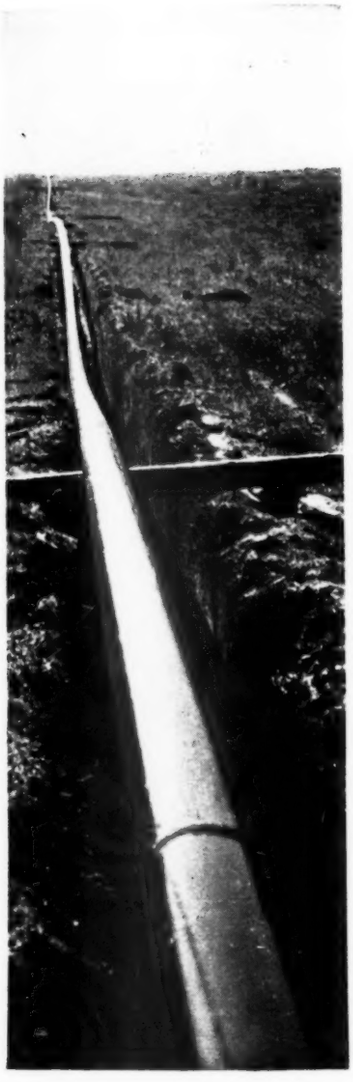
The only new proposal in the Southwest is that of the Moran Corporation of Houston. That company has plans for a 40-mile 12-inch line originating in the new Conroe area and terminating at Houston. The company is supplying gas to Conroe and plans to service only industrial consumers with the proposed 12-inch line. Two large transmission companies have lines running into Houston.

Stroud Contracting Company, Bakersfield, Calif., has completed one of the largest reconditioning jobs awarded to contractors during the past summer. That company completed repairing 32 miles of 10-inch line for the Southern California Gas Company from Taft to Grapevine.

In the same territory the Pacific Gas & Electric Company recently completed three miles of 16-inch line running from its Buttonwillow main line to a natural gasoline plant recently built in Kettleman Hills by the Standard Oil Company.

ON THIS LINE EACH WELDER

MADE 60 TO 70 WELDS A DAY



ON a Lindewelded natural gas line in Texas, each welder averaged 60 joints a day on 6 5-8 in. pipe, and 70 on 5 1-2 in. pipe.

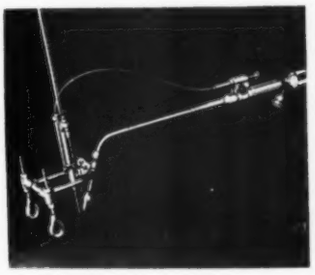
This record is not unusual. Lindewelding with an ordinary blowpipe lowers time 30 to 60 per cent. and lowers consumption of welding materials 35 to 40 per cent. With a special Lindewelder blowpipe, speed is further increased and welding becomes almost automatic.

Pipe lines laid by this new method of oxy-acetylene welding pass every test. Lindewelds are permanently strong and tight.

Procedure Controls for Lindewelding are available to all Linde customers through Linde Process Service. Consult our nearest district office for complete information.

See the Actual Steps in Lindewelding

Lindewelding technique differs from the neutral flame welding technique in that it employs a special rod, a special flame adjustment, and the "backhand" method of blowpipe manipulation. Our motion picture, "The Lindeweld Process for Pipe Line Construction," reveals the actual steps in making a Lindewelded joint. This picture, furnished in 16 mm. and 35 mm. safety film, will be loaned free of charge to pipe line officials and welding or engineering societies. You can obtain it by writing to any Linde District Office.



THE LINDEWELDER

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Unit of Union Carbide and Carbon Corporation

126 Producing Plants UCC 627 Warehouse Stocks

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Buffalo	Kansas City	Salt Lake City
Chicago	Los Angeles	San Francisco
Cleveland	Milwaukee	Seattle
Denver	Minneapolis	Tulsa

LINDE OXYGEN · PREST-O-LITE ACETYLENE · OXWELD APPARATUS AND SUPPLIES · UNION CARBIDE

PIPE LINES UNDER CONSTRUCTION AND CONTEMPLATED

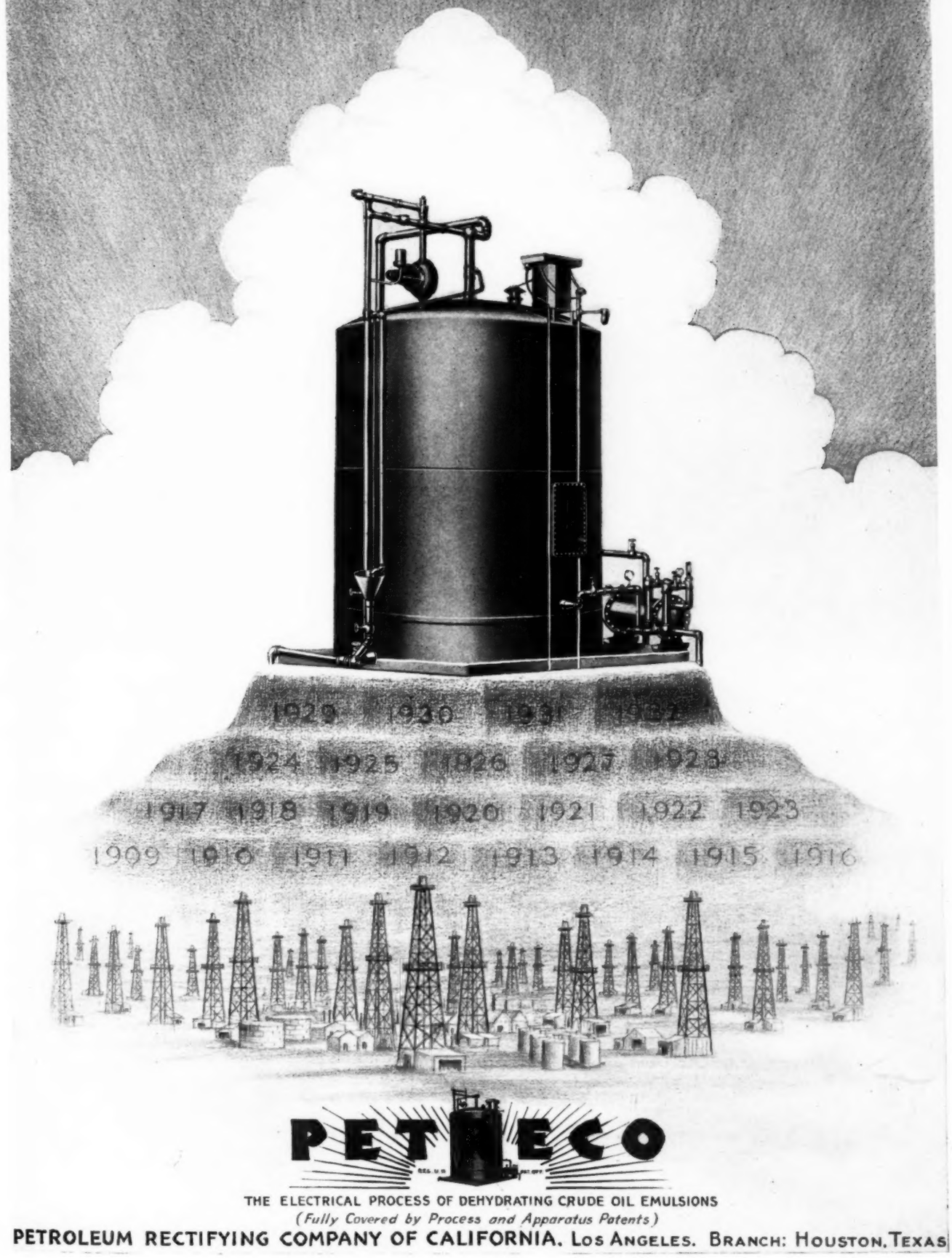
Type Line	Company Name	Headquarters	Point of Origin	Terminal	Size Pipe	Length in Miles	Remarks
G. L.	Bivens, C. E., et al.	Laramie, Wyo.	Baggs Field	Laramie, Wyo.	12"	104	Plan to build in 1932. Granted extension of time.
G. L.	Columbia Gas & Elec. Co.	New York, N. Y.	Ky. or Pan Eastern Line	Detroit, Mich.	20"	220	Considering going to Detroit, Mich., with line and to Toledo.
G. L.	Continental Constr. Corp.	Chicago, Ill.	Chicago, Ill.	Detroit, Mich.	20"	200	Plan extension of Panhandle line to Detroit.
G. L.	Continental Constr. Corp.	Chicago, Ill.	Point in Ill.	Wilwaukee, Wis.	20"	160	Under advisement.
G. L.	Cities Service, Insull, Texas Corp. & S. O. N. J.	(See Remarks)					Rumored considering building 1,500-mile project from Panhandle to Eastern cities.
G. L.	Golston, Roy D.	Tyler, Tex.	Brownwood, Tex.	Lampasas, Tex.			Considering building gas line.
Ga.L.	Great Lake Pipe Line Co.	Kansas City, Mo.	Okla. Midcontinent	Great Lakes Region	4-6-8"	1440	Installed one Booster Station.
G. L.	Great Northern Gas & Utilities Co.	Minneapolis, Minn.	(See Remarks)				Planning gas line from Baker-Glendive area in Montana to Minneapolis and St. Paul.
G. L.	International Util. Corp.	New York, N. Y.	Alberta, Canada	Vancouver, B. C.	20"	500	Proposed
G. L.	Kentucky Public Service Co.	(See Remarks)					Posted bond to build short line from Hart County, Ky., to Bardstown, Ky.
G. L.	Jerome Drumheller	Spokane, Wash.	Cut Bank, Wyo.	Seattle, Wash.	20"	500	Proposed.
G. L.	Lycoming Nat. Gas. Corp.	New York, N. Y.	Tioga Field, N. Y.	Syracuse, N. Y.			Building short line from Syracuse County line to Syracuse. Completed.
G. L.	Lycoming Nat. Gas Corp.	New York, N. Y.	Tioaga Field	Potter County Field	20"	40	Plan to build soon.
G. L.	Lewiston Nat. Gas Co.	Lewiston, Mont.	Armells Structure, Mont.	Montana Towns	4-6"	100	Proposed.
G. L.	Missouri Valley P. L. Co.	Omaha, Neb.	Point in Minnesota	Minneapolis, Minn.	16"		Proposed along with extension work in Iowa.
G. L.	Montana-Dakota Power Co.	Minneapolis, Minn.	Williams, N. D.	Minot, N. D.	12"	100	Applied to N. D. Commission for permission to build.
G. L.	Mo.-Kans. Pipe Line Co.	Chicago, Ill.	Russellville, Ky.	Nashville, Tenn.	10"	50	Proposed.
O. L.	Old Dutch Refining Co.	Muskegon, Mich.	East Michigan Fields	Muskegon	4"	100	Plans in abeyance.
G. L.	Ohio Oil Company	Findlay, Ohio	Weiser Field, Idaho	Boise and Northwest Area			Filed application for conveyance certificate.
G. L.	Pacific Gas & Elec. Co.	San Francisco, Calif.					Have appro. for $2,000,000 expansion campaign. Building 45 miles of 20-inch.
O. L.	Presidio Petroleum Co., Ltd.	Los Angeles, Calif.	Midland, Tex.	Topolobampo	10"	640	Propose to build to Mexican Port and erect two refineries, one at Chihuahua for domestic trade and the other at tidewater for export trade. Plan to parallel oil line with gas line to Chihuahua. J. F. Sadler promoting.
G. L.	Peninsular Pipe Line Construction Co.	Detroit, Mich.	(See Remarks)				Reported planning building 160-mile line from Mt. Pleasant field in Mich. to Detroit.
O. L.	San Juan Pipe Line Co.	Los Angeles, Calif.	San Juan County, Utah	Farmington, N. M.	8"	92	Reported planning to build this summer. Line will have three stations.
G. L.	Santa Maria Gas Co.	Santa Maria, Cal.	Santa Maria	San Ruis, Obispo	8"	21	Complete.
	Standard Oil Co., of Kansas		(See Remarks)				Plan to build 150 miles 8-inch into western Kansas.
	Southern Union Gas Co.	Dallas, Texas	Ute Dome	Kutz Canyon, New Mexico	6"	25	Half Completed.
G. L.	Wasatch Gas Company	Ogden, Utah	Ogden, Utah	Pocatello, Idaho	10"	140	Applied for permit to build welded line.

TABLE

O L.—oil line Ga. L.—gasoline line

G. L.—gas line

PETRECO'S PERFORMANCE RECORD IS INVULNERABLE



PETRECO

THE ELECTRICAL PROCESS OF DEHYDRATING CRUDE OIL EMULSIONS

(Fully Covered by Process and Apparatus Patents)

PETROLEUM RECTIFYING COMPANY OF CALIFORNIA. LOS ANGELES. BRANCH: HOUSTON, TEXAS

The Month's Activities in Refining*

By F. R. STALEY

REFINERIES in all divisions reduced crude runs to stills last month.

The Utah Oil Refining Company will build a vapor recovery and stabilization plant at its Salt Lake City refinery.

The Sinclair Refining Company is installing new units in its plants at Coffeyville, Kan., and Houston, Texas.

The Phillips Petroleum Company is building two new cracking units in the Borger, Texas, refinery.

The Midcontinent Petroleum Corporation, West Tulsa, Okla., is installing a new cracking unit.

The Gulf Refining Company will erect a topping plant on Staten Island, New York.

Contracts have been made by two French oil companies for the building of a combination primary cracking, vapor phase cracking, and reforming unit, with stabilizer and rerun still at Port Jerome and at Frontignan, France. The M. W. Kellogg Company, construction agents for Gasoline Products Company, announces that the operation of both cracking installations will be under the Gasoline Products Company-Socony-Vacuum Corporation license. The daily charging capacity of each unit will be, in the aggregate, about 2700 barrels of topped crude, kerosene, and naphtha stocks.

The fourth semi-annual meeting of the Cracking Development Conference was held September 14-17 in New York City. The object was to correlate experimental and plant development work in cracking, which was carried on in the laboratories and refineries of The Texas Company, Standard Oil Company of Indiana, Gasoline Products Company and the M. W. Kellogg Company. Improvements passed by this conference are incorporated by the Kellogg Company as engineering and licensing agents, in designs for new cracking installations of licensees of Gasoline Products Company.

A liquid gum inhibitor, which effectively halts formation of gum when added to fresh cracked gasoline, has been developed by the research department of the Universal Oil Products Company. It is now available to all refiners. One gallon or less is used in 100 barrels of gasoline.

A metallurgical meeting was held by the American Society of Mechanical Engineers in Tulsa, October 4-5. Many excellent papers on the application of metals in the petroleum industry were presented.

The Southwestern Engineering Corporation, Los Angeles, Calif., has been granted exclusive license by the Jenkins Petroleum Process Company and the Donnelly Process Corporation to engineer, manufacture, sell and erect Jenkins or Donnelly Cracking Units in the United States.

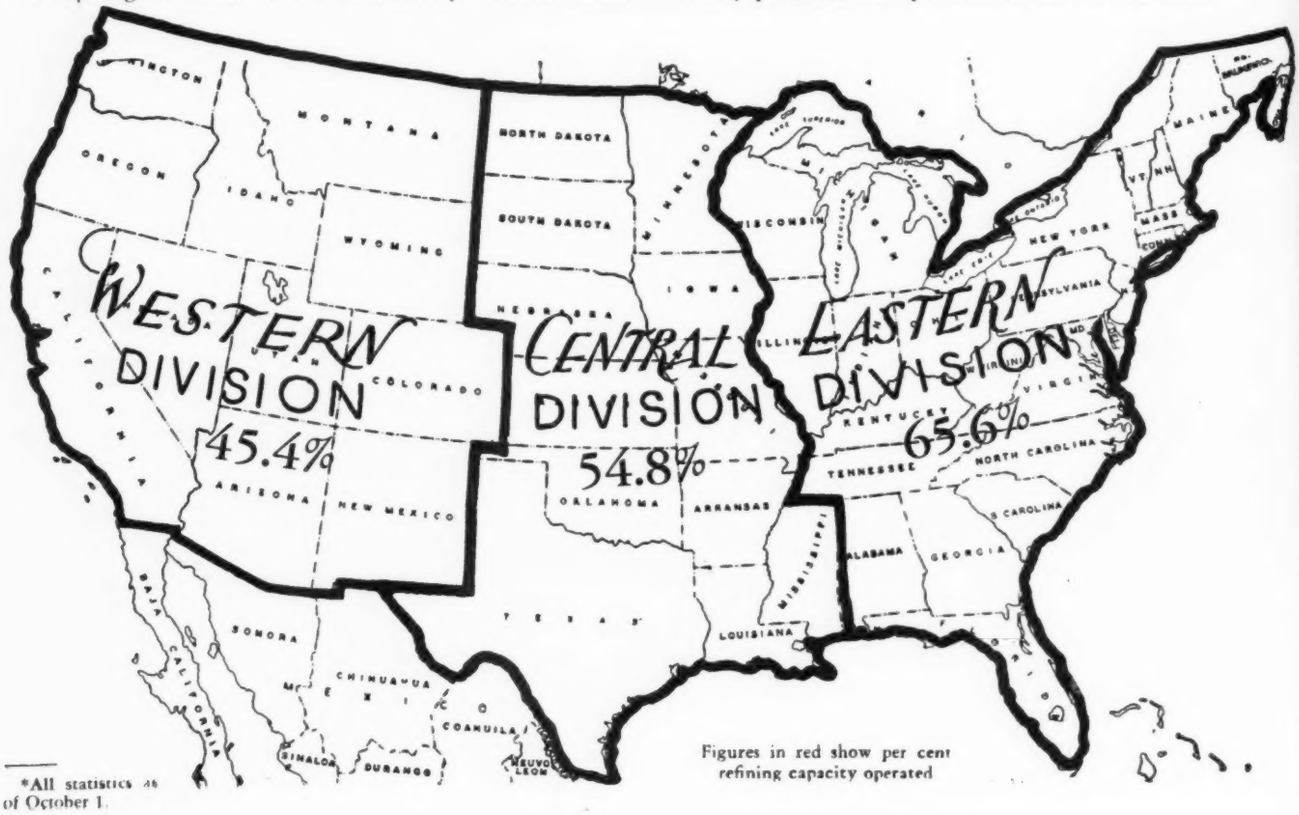
The Imperial Oil Company, Ltd., has an expansion program under way at its Halifax, N. S. refinery. The company will erect storage facilities at Fort Churchill, Hudson Bay, from which to supply Western Canada.

The Danciger Brothers have recently organized the Red Ball Refining Company, a Texas corporation, for the purpose of constructing and operating a refinery near Pampa, Texas.

Natural Gasoline

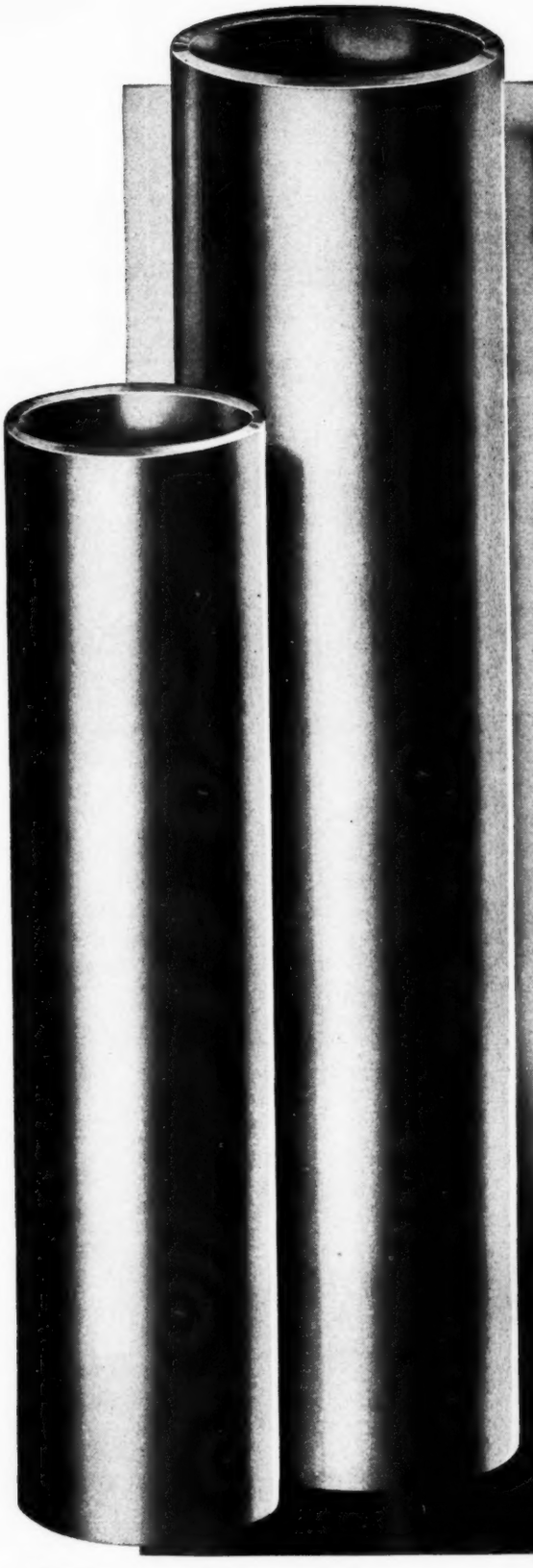
According to the United States Bureau of Mines Survey recently released the production of natural gasoline in 1931 totaled 1,831,918,000 gallons, which is a decline of 17 per cent from the previous year. California retains first place as a producer, and Oklahoma and Texas rank second and third respectively. These three states produced 85 per cent of the country's total output in 1931.

Of the total world output of 2,122,168,000 gallons in 1931, the United States produced 86.3 per cent. In 1927 this country produced 94.2 per cent of the world's total.



Figures in red show per cent refining capacity operated

*All statistics as of October 1.



NATIONAL USS STAINLESS AND HEAT RESISTING PIPE AND TUBES

This superior tubular material offers these outstanding advantages:

- High resistance to corrosion.
- Maximum strength at high temperatures.
- Unusual resistance to oxidation or scaling.
- Dependable uniformity in structure, in strength and in quality.
- Accurate, controlled heat treatment.
- Exceptional ductility.
- Seamless—no welds.
- Widest range of diameters, wall-thicknesses and lengths.
- Furnished with plain, upset, or otherwise formed ends.
- Large assortment of sizes in stock for immediate shipment.
- Sentry drilled (when ordered)—an exclusive patented feature.

The high quality and general adaptability of these exceptional tubes make them particularly attractive from the standpoint of both economy and durability. They are especially recommended for cracking tubes and for piping in heat exchangers, ducts, containers, tanks, agitators and other refining equipment where hot oil is handled.

NATIONAL Engineers and Metallurgists will gladly lend their aid in determining the best application of stainless and heat resisting pipe and tubes to your particular requirements.

USS 5-7 Chromium-Nickel Alloy Steels are produced under the licenses of the Chemical Foundation, Inc., New York; and Fried. Krupp A. G. of Germany.

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SUBSIDIARY OF UNITED STATES STEEL CORPORATION

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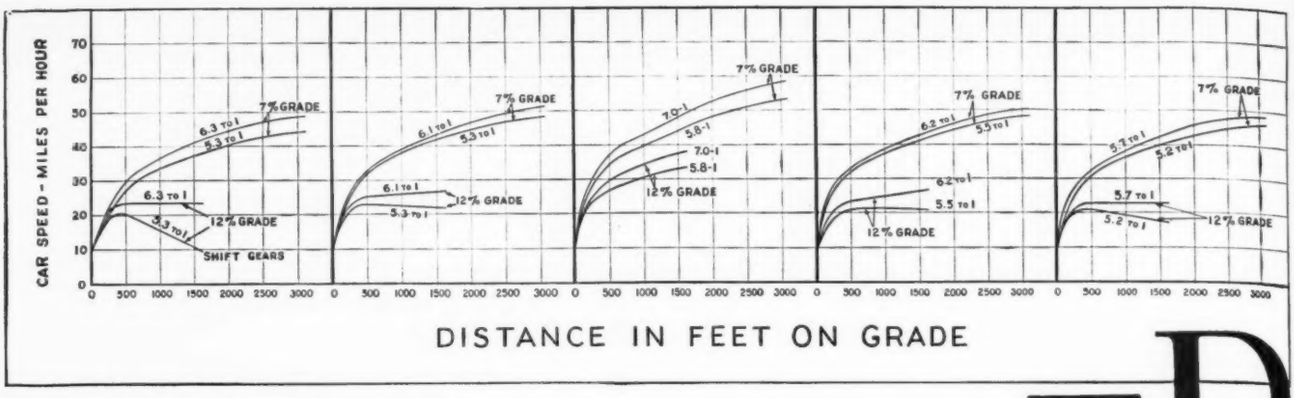
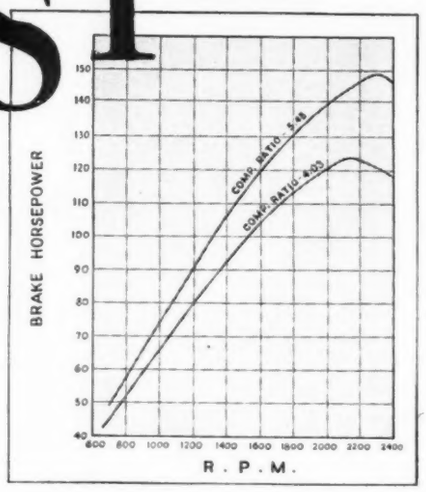
FEDERAL SHIPBUILDING AND DRY DOCK COMPANY
ILLINOIS STEEL COMPANY
NATIONAL TUBE COMPANY
OIL WELL SUPPLY COMPANY
THE LORAIN STEEL COMPANY
TENNESSEE COAL, IRON & R. R. COMPANY
UNIVERSAL ATLAS CEMENT COMPANY

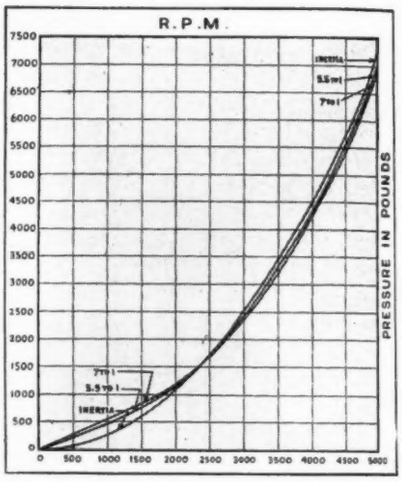
Pacific Coast Distributors—Columbia Steel Company, Russ Building, San Francisco, Calif. *Export Distributors*—United States Steel Products Company, 30 Church Street, New York, N. Y.



Better hill-climbing ability—*records of hill-climbing tests for five 1932 production cars are plotted above, comparing their performance with low compression ratio to that of high compression ratio. Car speed in miles per hour is shown in vertical scale. Distance up grade is shown in horizontal scale. All tests were made in high gear with cars moving ten miles an hour from a point a few feet preceding start of grade.*

They STEPPED



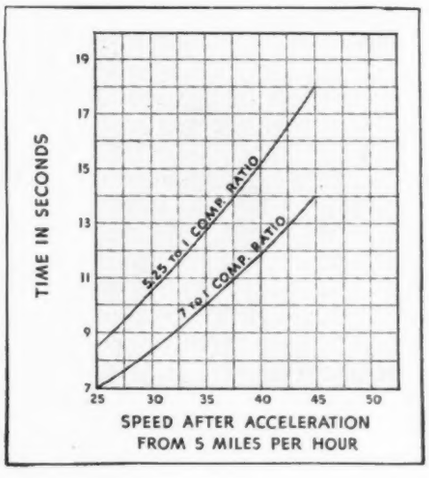


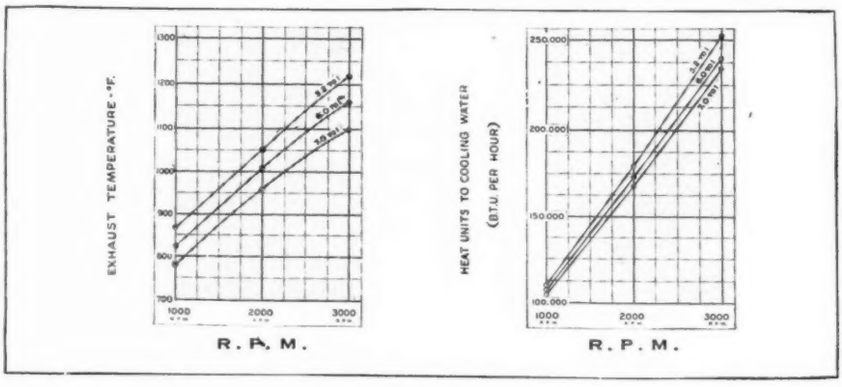
Lower extreme bearing pressures (ABOVE). *At higher speeds, the forces of inertia on crank pin bearings are greater than, and opposed to, the gas pressure in combustion chambers. Increased gas pressure therefore lowers the mean resulting load on crank pin bearings at high speeds. At low speeds, crank pin loads present no problem.*

Other Gains Offered by High Compression Are:

Greater power—(RIGHT). *Many tests with passenger car engines prove that increasing compression ratio from 5-to-1 to 7-to-1 increases power approximately 15% at any given speed and steps up top speed 4 to 6 miles per hour. The chart at the right shows the gain in horsepower effected by increasing compression of a large bore truck engine.*

Faster acceleration—(BELOW). *With 5.25-to-1 compression ratio a given car (not one of those included in above hill-climbing tests) accelerated from 5 miles per hour to 45 m.p.h. in 18 seconds. With 7-to-1 compression ratio the same car reached 45 miles per hour in approximately 14 seconds.*





Less heat to cooling water and exhaust—(ABOVE). *By a more efficient use of the fuel energy, higher compression ratios maintain cooler engine temperatures at any given r.p.m. The lower exhaust gas temperatures impose less heat on exhaust valves and transmit less heat to the driving compartment in hot weather. Less heat transmitted to cooling water by higher compression engines offers relief to overloaded radiators in your new, more powerful models, rather than a further strain.*

UP performance ... at NO increase in manufacturing cost

Improvements resulting from major increases in compression ratio are already being demonstrated by production cars on the road

THERE ARE 1932 cars in all price classes now delivering performance that can be produced only by high compression engines.

The results of hill-climbing tests on five such cars at high and low compression ratios are shown by the curves at the top of the opposite page. These cars vary widely in price, in permissible compression ratio, and in actual performance figures. In every case the increase in compression ratio provided performance gains that add greatly to the car value.

On some of these cars, high compression ratio is standard; on others it is offered at the purchaser's option. Most of the cars having standard high compression also offer an optional lower ratio, although few buyers to whom the high compression car is demonstrated are satisfied with the decreased performance of low compression.

Other benefits of increased compression, higher peak power engine speed, faster car acceleration, less heat to cooling water, lower exhaust gas temperatures, and lower extreme bearing loads, are illustrated by the remaining charts. The fact that realizing these various advantages involves no costly redesigning or retooling is of importance to which attention need hardly be directed.

High compression production cars, driven by enthusiastic owners, are now setting the standards of performance by which the car-buying public will judge 1933 cars. Will your 1933 car take advantage of the compression made possible by Ethyl Gasoline to get the kind of performance that will win more sales next year?

Engineers of the Ethyl Gasoline Corporation have had wide experience with high compression engines. They will be glad to cooperate with you in the development of high compression for your new model. Ethyl Gasoline Corporation, Chrysler Building, New York City, N Y.

A Comparison of Natural Gas Absorption Methods at 35 and 150 Lbs. Gauge Pressures

By M. E. GARRISON, Design Engineer General Petroleum Corporation • PART I

THIS comparison of natural gas absorption methods is made for the purpose of bringing to the attention of the oil industry, and of the designing engineer of absorption plants in particular, the advantages of choosing the proper absorption pressures for use in the original design of the absorption plant. This pressure affects the entire operation of the oil property from the time the gas leaves the well until it is sold as dry gas. The pressure of the wet gas leaving the well as a natural decline curve of several hundred pounds from the time the well is brought in until the well is placed upon the pump, when only a few pounds pressure remain. This gas has to be treated and the natural gasoline extracted throughout the life of the well. The choice of the proper absorption pressure or pressures will greatly facilitate the handling of it.

The choice of new equipment to transport and to treat the gas from a new oil field has in the past been almost entirely dependent upon the initial well pressure. If the initial well pressure is high, the installation cost is also relatively high.

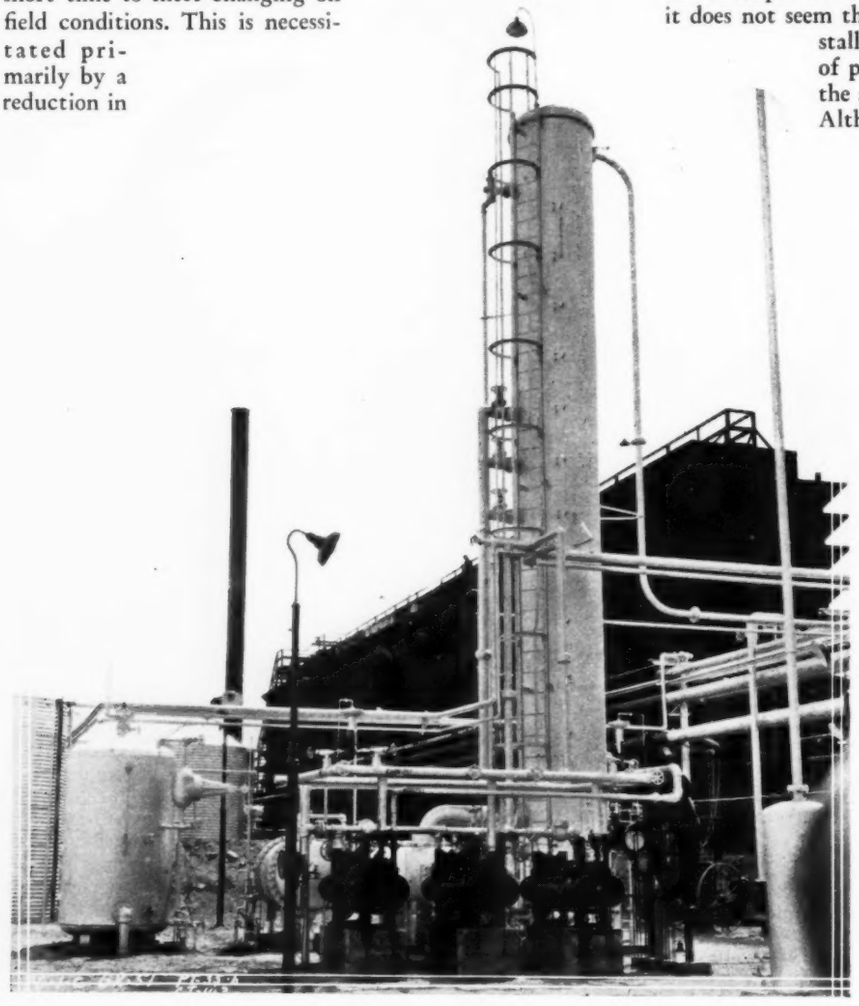
Absorption plant equipment chosen for flush field conditions in nearly every instance has to be added to, rebuilt, or otherwise changed in a relatively short time to meet changing oil field conditions. This is necessitated primarily by a reduction in the initial gas pressure in the field. Before the installation of gas and oil curtailment methods the well pressures in any flush field declined rapidly, along with a similarly rapid decline in the oil and gas production. Under this condition the new absorption plant installation had it pay itself out during the flush production period. Since the development of oil and gas curtailment methods the decline of the initial well pressure and of the oil and gas production is very much less. Also the daily quantity of oil and gas produced per well has been greatly reduced. As a result, the choice of proper absorption equipment under this condition has to be more carefully made, reduced daily production quantities making it necessary that the oil property be operated under a smaller daily margin of profit.

The uncertainties of future conditions, whether the oil property is operated under wide-open flush field methods or under curtailment methods, cause the oil operator to hesitate possibly before installing adequate absorption plant facilities. As a result, many thousands of cubic feet of wet gas are often blown into the air and lost.

An example of this condition at present may be found in the East Texas field. Due to the small oil and gas production allowable per well and to the relative wide spacing of the wells it does not seem that absorption plant equipment can be installed profitably. Because of the large number of producing wells the total wet gas blown to the air from this field is an amazing quantity. Although the scope of this paper does not permit of further discussion of this particular phase of the problem, the remedy can be made very simple, its solution being dependent upon two things: first, a plan based on an equitable understanding of the problem; and, second, the proper cooperation among neighboring operators in order to carry out the plan.

The standardization of certain gas pressure levels for handling the gas in all the absorption plants in any new oil field would create a better understanding of natural gas and gasoline plant operations and would tend to stabilize this branch of the industry. The designing engineer could design equipment to meet present and future demands, the gas conservation laws could be more easily observed and there would be less waste of natural resources.

The dry gas sales pressures are the deciding factors in the choice of proper absorption pressures. However, the gas company to whom the dry gas is sold usually agrees to take the gas at your own plant pressure. But it is to be noted that, in some oil fields several years old, which are absorbing at from 35 to 150



Stabilizing Unit in a California natural gasoline plant

pounds pressures, the gas company will give a bonus of from one to two cents per thousand cubic feet for this same gas at pressures of 150 pounds and above. Hence the desirability of selling the gas under optimum conditions.

Why are 35 and 150 pounds gauge pressure chosen for the pressures upon which to base this comparison? As the initial well pressure declines the installation of gas compressor stations becomes necessary to raise the pressure to a point where the gas can be properly utilized. The choice of economic compressor cylinder sizes depends to a large extent upon the compression ratio which is designated as R. This ratio R is the ration of the absolute compressor discharge gas pressure to the absolute compressor intake gas pressure in pounds per square inch. The primary reason for choosing 35 and 150 pounds gauge pressures is to obtain a value for R which will determine the most economic compressor cylinder sizes to choose for the compressor station. Let us observe what these compression ratios are. Compressing from atmospheric pressure to 35 pounds gives a compression ratio of R=3.38; compressing from 35 to 150 pounds gauge pressure gives a compression ratio of R=3.31. If it is desired to compress the gas to a higher pressure for gas lift work, repressuring, or for sales, 500 pounds is a very suitable design pressure for this work. Compressing from 150 to 500 pounds gives a compression ratio of R=3.12. It is to be observed that the compression ratio for all three stages of compression is roughly the same. This is desirable in choosing economic compressor cylinder sizes and for balancing the pressures on the gas systems to meet the inevitable changes in capacity that will come about during the life of the field.

For purposes of calculation, let us assume that we have 10,000 M cubic feet of wet gas, which is available at the absorption plant at 35 pounds gauge pressure. Ordinarily in the past 35 pounds would be the absorption pressure and the plant would be designed on this basis. For the purposes of calculation it is assumed that we are not satisfied with 35 pounds as the proper absorption pressure. Let us assume also that we desire to compress this wet gas to 150 pounds gauge pressure and then absorb at this pressure. What are going to be the advantages of the two types of installation?

In order to make this comparison of interest, suppose that we have available a low pressure gas at around 35 pounds, of approximately the same characteristics as some of the low pressure gas at Kettleman Hills. Let us assume that its composition is approximately as follows:

Analysis	*% by Volume*	*Content Gasoline*
Methane - - -	61.00	
Ethane - - -	15.44	
Propane - - -	12.41	
Iso-Butane - -	2.45	0.80
Butane - - -	4.36	1.38
Pentanes-Plus -	4.34	1.68
Total - - -	100.00	3.86

This comparison is made on a purely mathematical basis for a gas of chosen characteristics. The effects of deviation from natural gas laws and minor changes in composition will vary the results, but in general will not materially vary the final observations. A radical change in composition of from, say, three gallons to one-half gallon of recoverable gasoline per thousand cubic feet of gas will, of course, change the results. However, it is to be noted that, in general, the higher the percentages of Propane and Iso-Butane in the gas the more favorable will be the 150-pound absorption method. Also it is to be noted that the higher the gasoline content of the gas the larger will be the volume of condensate produced. As a result the more efficient will be the 150-pound absorption for a given oil circulation.

The mathematics involved in making this comparison are next given so that the reader may be able to apply the same reasoning to his own set of conditions.

From the absorption angle there are three ways of looking at the problem, namely:

(1) Calculations based upon ideal gas laws; (2) Calculations based upon average plant conditions; (3) Calculations based upon a 99 per cent extraction of the gasoline content from the gas. These will be applied to our problem in order named.

The calculations based upon the ideal gas laws will be made according to Raoult's and Dalton's Laws. Raoult's law states that the vapor pressure of a compound above the perfect solution in which it is held is the product of its vapor pressure in the pure state at that temperature in the pure state and its mol fraction in the liquid, namely:

$$\text{Mol Fraction} \times \text{Vapor Pressure} = \text{Partial Pressure.}$$

Dalton's law states that the partial pressure of a compound in a gas is the product of its percentage in the gas and the total pressure on the gas, namely:

$$\text{Percentage} \times \text{Total Pressure} = \text{Partial Pressure}$$

By combining these two equations there is developed a value for the Mol Fraction of any compound in a solution in terms of the vapor pressure of the pure compound and the percentage composition of that compound in the gas above the solution:

$$\text{Mol Fraction} = \frac{\text{Percentage} \times \text{Total Pressure}}{\text{Vapor Pressure}}$$

Table 1 is calculated for determining the rich oil equilibrium in the absorber based upon the above fundamental laws. For the 35-pound pressure condition the temperature of the rich oil leaving the absorber has been assumed as 85 degrees F. and for the 150-pound pressure condition the temperature of the rich oil leaving the absorber has been assumed as 95 degrees F.

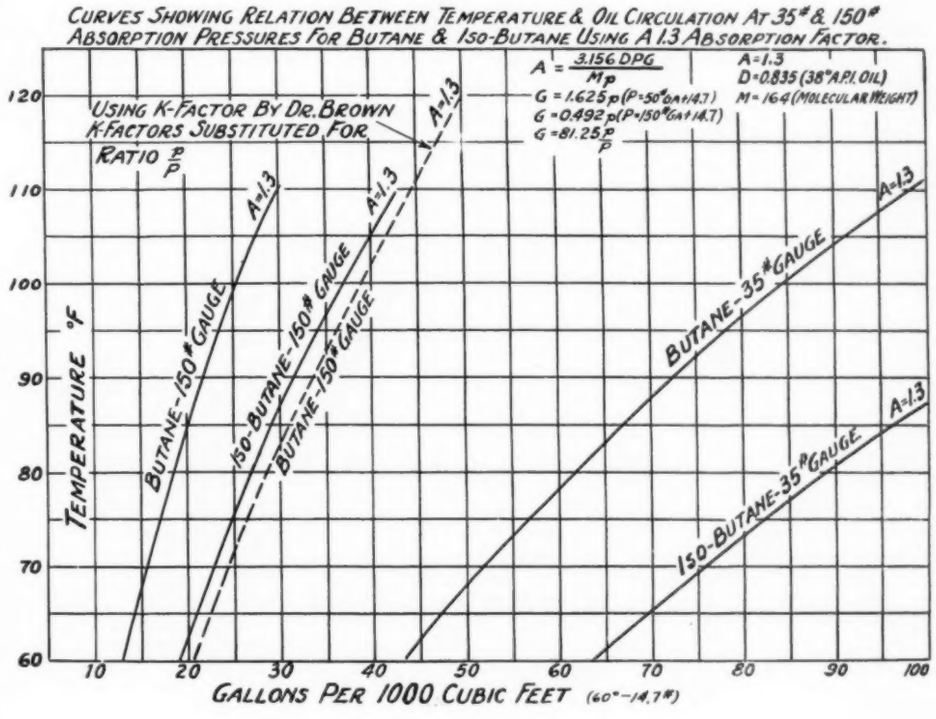


TABLE 1

Column 1 Component	Column 2 % by Volume	Column 3 Partial Pressure Col. 2 × P	Column 4 Abs. Vapor Pressure of Pure Component at 85° F.	Column 5 Rich Oil Equilibrium = Mol Fraction = Col. 3 ÷ Col. 4
Methane - - -	61.00	30.50	3100#	.0099
Ethane - - -	15.44	7.72	650	.0119
Propane - - -	12.41	6.20	155	.0400
Iso-Butane - -	2.45	1.23	59	.0208
Butane - - - -	4.36	2.18	41	.0532
Pentane Pl. (Residue) - -	4.34	2.17	8	.2713
Total - - -	100.00	50.00=P		.4071

The Residue is assumed to be ½ Hexane and ½ Propane.

The next step is to choose the point at which equilibrium is to be taken in the gas. For the basis of this calculation in Table 2 it is assumed that equilibrium is to be taken on the Iso-Butane. Table 2 is computed to determine the quantity and composition of the rich oil upon this basis.

TABLE 2

	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12
	Available per M Cu. ft.			0.32 M Cu. ft. Equilibrium	= Col. 5 Rich Oil Composition	Rich Oil Composition	
Component	Cu. ft.	Gals.	# Mols	# Mols	# Mols	# Mols	% Saturation
Methane -	610.0	10.0	1.608	.515	.0099	.0099	100%
Ethane - -	124.1	3.41	.410	.131	.0119	.0119	100%
Propane -	124.1	3.36	.328	.105	.0400	.0400	100%
Iso-Butane -	24.5	0.80	.065	.0208	.0208	.0208	100%
Butane - -	43.6	1.38	.115	.0368	.0532	.0368	69%
Pentane Pl. (Residue) -	43.4	1.67	.107	.0342	.2713	.0342	14%
Absorption Oil						.8464	
Totals	1000.0		2.633			1.0000	

Column 8 shows for Iso-Butane .065 number Mols, but for equilibrium in the rich oil from column 5 requires .0.32 M Cu. ft. = Col. 5 ÷ Col. 8 = .0208 ÷ .065. This the theoretical number of cubic feet of gas required to give equilibrium in the rich oil on Iso-Butane. Col. 11 is the rich oil composition which is the lessor of Col. 9 or 10. The sum of the components in Col. 11 subtracted from 1.0 be the number Mols of absorption oil required for 0.32 M. Cu. ft. of gas for equilibrium conditions based upon equilibrium on the Iso-Butane content of the gas. The molecular weight of 38 A.P.I. absorption oil is 164 and its specific gravity is 0.835 and its weight per gallon is 6.95 pounds. Therefore 0.32 M Cu. ft. of gas will require theoretically $\frac{164 \times 0.8464}{6.95} = 25$ gallons of absorption oil or 64.5 gallons of absorption oil are required per M Cu. ft. of gas.

In the case of the 150-pound absorption pressure we have first to compress the wet gas from 35 to 150 pounds and then the gas should be cooled to 80 degrees F. temperature before going to the absorbers. After the gas leaves the coolers it should go to the scrubber, where the condensate can be removed. The removal of this condensate before absorption reduces the load upon the absorbers.

In order to calculate the composition and amount of condensate resulting from compressing this gas from 35 pounds to 150 pounds, and the resulting composition of the wet gas to the absorbers, we can use the equations by E. R. Cox and Dr. G. Brown. These equations are modifications of Raoult's and Dalton's Laws.

Applying Raoult's law to a gas gasoline equilibrium containing various hydrocarbons we get the following equations:

(I) $\frac{L_n VP_n}{L} = \frac{V_n P}{V}$ (Cox) where

n (subscript) = Represents hydrocarbon component in the liquid
L_n = Mols of component n in the liquid
L = Mols of total liquid
V_n = Mols of component n in the gas
V = Mols of total gas
VP_n = Vapor pressure of the pure component n
P = Working pressure in pounds per square inch absolute.

For the development of this equation see Vol. IV, Nos. 6 and 7 of the Proceedings of the California Natural Gasoline Association:

(II) $\frac{X_n - V_n}{100 - V}(VP_n) = \frac{V_n}{V}P$ (Brown) Where

V = Total Mols of vapor on basis of 100 Mols of Feed
X_n = Mol % of hydrocarbon indicated by subscript in the Feed
100 — V = Total Mols of liquid residue at equilibrium after condensing
V = 100 — L = Mols of gas at equilibrium after condensing
$X_n - V_n = L_n$ = Mols of component liquid residue at equilibrium.

Knowing the values of VP_n, P, V, and X_n we can compute V_n, provided we assume a value of L on the basis of 100 Mols of Feed.

Now for any problem of condensation we must assume values for L and solve for V_n and L_n for each component in the gas and in the liquid. When these values have been computed it will be found that for perfect equilibrium that the sum of the L_n's must equal L, and the sum of the V_n's must equal V. If these sums come out differently than those assumed we have to assume another value for L until we arrive at the proper balance by cut and try methods. X_n is obtained from the actual analysis made of the gas to be condensed.

For the development of this equation see Vol. III, No. 11 of the Proceedings of the California Natural Gasoline Association:

(III) $X_n - V_n = \frac{V_n P (110 - V)}{V (VP_n)}$

Our equation (III) can be further simplified as follows:

(IV) $L_n = V_n \times \frac{L}{V} \times \frac{P}{VP_n}$ and

(V) $L_n = (X_n - L_n)\frac{L}{V} X \frac{P}{VP_n}$

(VI) $V_n = \frac{V}{L} \times \frac{VP_n}{P} \times L_n$

(VII) $X_n = V_n + V_n \frac{(100 - V)}{V} \times \frac{P}{VP_n}$

On this basis the following tables show the method of applying these equations for computing the amount of condensate, its composition, and the composition of the wet gas remaining after cooling, which will go to the 150-pound absorbers:

TABLE 3—CONSTANTS

Component	Column 1 Composition % by Volume	Column 2 Partial Pressure (Col. 1×P)	Column 3 Vapor Pres. of Pure Component at 80° F.—VP_n	Column 4 Mol Fraction Col. 2 ÷ Col. 3	Column 5 Ratio P (VP_n) P÷Col. 3
Methane - -	61.00	100.65	3000	.0336	.0550
Ethane - -	15.44	25.48	608	.0419	.2712
Propane - -	12.41	20.47	152.5	.1341	1.0813
Iso-Butane -	2.45	4.04	55	.0735	3.0000
Butane - -	4.36	7.20	36.2	.1980	4.5500
Pentanes Pl. (Residue) -	4.34	7.16	6.75	1.0600#	24.4445
Totals -	100.00	165.00=P		1.5411	

#Note: By Dalton's law this component will be condensed as a liquid, hence condensate will be formed on cooling the 150-pound gas. The Residue is assumed to be ½ Pentane and ½ Hexane.

The assumed ratio $\frac{L}{V}$ for balancing the above equation was found by cut and try methods to be $\frac{4}{96} = .04167$.

X_n was found from Column 1 of the above Table 3

TABLE 4—COMPOSITIONS

Component	Col. 6 Composition of Gas Mols	Col. 7 % By Vol. Col. 6 ÷V	Col. 8 Partial Pressure Col. 7 ×165 lb	Col. 9 Mols		Col.10 Composition of Liquid Liquid Gals.	Col.11 % By Vol. Col.10 ÷Total	Col.12 Mol Fr'ct'n Col. 9 L	Col.13 Partial Pressure Col.12 ×Col.3
Methane	60.86	63.39	105.3	0.14×	16.03 / 2.58 =	0.87	1.69	.0350	105.0
Ethane	15.26	15.90	26.1	0.17×	30.05 / 3.67 =	1.39	2.70	.0435	25.9
Propane	11.89	12.39	20.4	0.52×	44.06 / 4.30 =	5.34	10.35	.1300	19.9
Iso-Butane	2.18	2.27	3.7	0.27×	58.08 / 4.69 =	3.35	6.50	.0675	3.7
Butane	3.66	3.82	6.0	0.70×	58.08 / 4.85 =	8.38	16.28	.1750	6.4
Pentanes Plus	2.14	2.23	3.5	2.20×	79.00 / 5.40 =	32.20	62.48	.5500	3.8
Totals	96.00	=V100.00	165.0	4.00 =	L	51.53	100.00	1.0000	164.7

Column 13 is a check on the calculations since the partial pressure in the liquid must be equal to that in the gas for equilibrium conditions.

Column 7 is the calculated composition of the remaining wet gas to the 150-pound absorbers after removing the condensate.

TABLE 5—QUANTITIES

Component	Col. 14 Volume in Cu. Ft.	Col. 15 Gallons Col. 14 ÷Cu. Ft. per Gal.	Col. 16 Recoverable Gallons Total in Gas	Col. 17 Liquid Removed Col. 10 ÷ 38 — Gals	Col. 18 150# Wet Gas — Col. 15 — Col. 17 Gals.	Col. 19 960 M Cu. Ft. Gals. to be Recovered in 150 lbs. Absorbers
Methane	610.0			.023	9.977	
Ethane	154.4	3.41		.037	3.373	
Propane	124.4	3.36		.141	3.219	
Iso-Butane	24.5	0.80	0.80	.088	0.712	0.712
Butane	43.6	1.38	1.38	.221	1.159	1.159
Pentanes Pl. (Residue)	43.4	1.68	1.68	.848	0.832	0.832
Totals	1000.0	10.63	3.86	1.358	19.272	2.703

For 1000 cubic feet of gas there is 2.63 Mols at standard conditions. For 100 Mols of feed there will be required 38M cubic feet of gas. Therefore Col. 17 is derived by dividing Col. 10 by 38 for 1000 cubic feet of gas; and 51.53 ÷ 38 = 1.36 gallons of condensate will be condensed per M cubic feet of wet gas.

In the 150 pounds of wet gas there will be, therefore, 2.703 ÷ .96 = 2.82 gallons of recoverable gasoline including the Iso-Butane, per M cubic feet of gas.

For the 10,000 M cubic feet of gas per day there will be condensed 11,570 gallons of gasoline in the gas coolers.

Proceeding for the absorber equilibrium for the 150 pounds absorption in the same manner as for the 35 pounds absorption we get the following results:

TABLE 6

Component	Column 1	Column 2 % by Volume Col. 17 — IV	Column 3 Partial Pressure Col. 2×P	Column 4 Vapor Pres. of Pure Component at 95° F.	Column 5 Rich Oil Equilibrium Mol Fr. Col. 3÷Col. 4
Methane		63.39	105.3	3250	.0463
Ethane		15.90	26.1	720	.0362
Propane		12.39	20.4	175	.1165
Iso-Butane		2.27	3.7	69	.0536
Butane		3.82	6.0	46	.1305
Pentanes Plus		2.23	3.5	9.3	.3760
Totals		100.00	165.0=P		.7591

The next table is computed to determine the composition of the Rich Oil on the assumption that equilibrium is taken on the Iso-Butane.

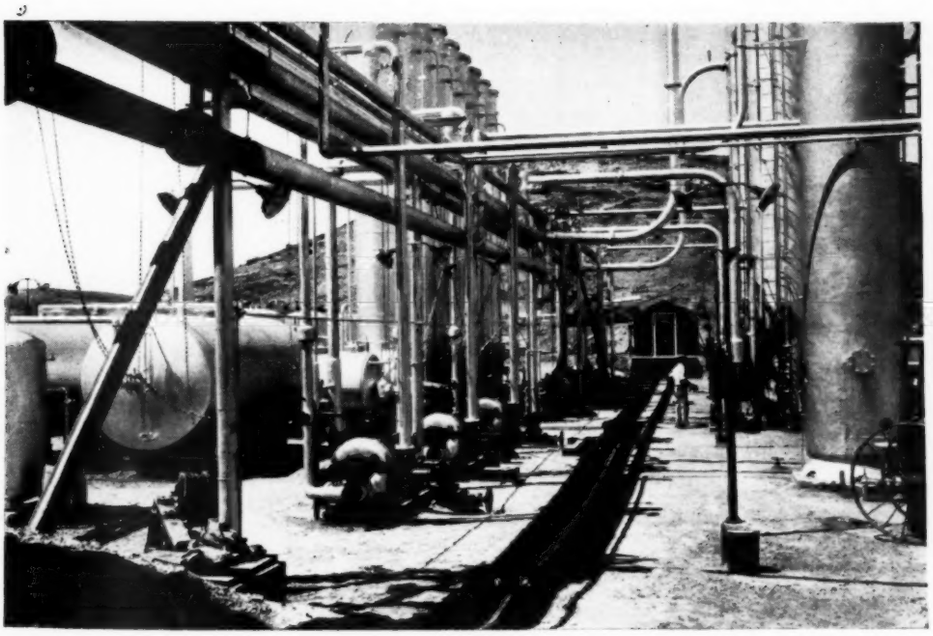
TABLE 7

Component	Col. 6 Available per M Cu. ft. Cu. ft.	Col. 7 Gals.	Col. 8 # Mols	Col. 9 .908 M Cu. ft.=Col. 5 Rich Oil Equilibrium # Mols	Col. 10 # M	Col. 11 Rich Oil Composit on # Mols	Col. 12 % Saturation
Methane	633.9	10.48	1.680	1.5250	.0463	.0463	100%
Ethane	159.0	3.51	.428	.3881	.0362	.0362	100%
Propane	123.9	3.35	.326	.2960	.1165	.1165	100%
Iso-Butane	22.7	0.74	.059	.0536	.0536	.0536	100%
Butane	38.2	1.21	.101	.0915	.1305	.0915	70%
Pentanes Pl.	22.3	0.86	.059	.0535	.3760	.0535	14%
Absorp. Oil						.6024	
Totals	1000.0		2.653			1.0000	

Column 8 shows for Iso-Butane .059 number Mols, but for equilibrium in the rich oil from Col. 5 requires — Col. 5 ÷ Col. 8 = .0536 ÷ .059 = .908 M. Cu. ft. This is the theoretical number of cubic feet of gas to give equilibrium in the rich oil on Iso-Butane. Col. 11 is the rich oil composition and is the lesser of Cols. 9 and 10. The sum of the components in Col. 11 subtracted from 1.0 will be the number of pound Mols of absorption oil required for .908 M Cu. ft. of gas for Iso-Butane equilibrium. The molecular weight of 38° A.P.I. absorption oil is 164 and its weight per gallon is 6.95 pounds. Therefore, 0.908 M cubic feet of gas will require

$$\frac{164 \times .6024}{6.95} = 14.2 \text{ gallons,}$$

and 14.2 ÷ .908 = 15.7 gallons per M cubic ft.



View in a California Natural Gasoline Plant

EDITOR'S NOTE

The second of two articles on this subject will appear in an early issue.

New Conroe Order Based on Modern Engineering Principles

By WARREN L. BAKER

A PRECEDENT that may exert an important influence on future oil producing practices, as well as proration regulations, was established by the Texas Railroad Commission recently when it issued an order governing the conservation and prevention of waste of crude petroleum and natural gas in the Conroe field, Montgomery County, Texas. The order is the most modern and elaborate yet adopted by any oil regulatory body and gives official recognition to advanced petroleum engineering ideas on efficient production methods, straight hole drilling, well spacing and gas conservation. Another new step was the requirements stipulating the use of certain quality oil field equipment to safeguard against dangerous practices.

It will be extremely interesting to watch the results obtained in this field, as it is the first important attempt by regulation to apply such engineering factors to a competitive area. Engineers and production officials for a number of years have strongly advocated the adoption of such producing practices, but in only a few instances have they been possible, because of competitive development and clashing methods, to apply them to an entire oil pool. The Conroe experiment should be highly successful in obtaining efficient oil production, including limited expenditures for development and longer productive life.

The most important oil and gas production trend in recent years has been toward the conservation of original pressure in flush fields. The underlying purpose of maintenance of reservoir pressure has been in the interest of greater ultimate production at a lower cost. This trend has been so widely accepted that it has resulted in the universal practice of producing wells to conserve reservoir gas by flowing through tubing and the use of chokes to restrict the flow to secure low gas-oil ratios. Gas-oil ratio is now generally accepted as the basis for measuring the efficiency of oil production. We have also learned that maintenance of pressure properly applied must have its inception in the early life of a field. Observations in unregulated pools indicate that about 90 per cent of the physical or underground waste occurs during and immediately following the flush stage of production.

The Conroe order governing development practices in the field provides that all wells shall be equipped with and produced through tubing of not more than two and one-half inches diameter. The bottom of the tubing string is not to be higher than within one joint of the top of the producing sand. If the tubing is perforated, the perforations are not to extend above the top of the sand. All wells are also to be equipped with adequate chokes, or beans. The gas-oil ratio per barrel is not to exceed 2000 cubic feet. These regulations adhere to all modern engineering principles and are the most important stipulations placed in the order, although a number of other vital factors are carefully regulated by the Commission.

It is the plan of the Commission for Conroe to be developed on the basis of one well to each 20 acres, with the exception of the wells already completed or drilling. No well is to be drilled at any point less than 933 feet from any drilling or completed well, and is not to be closer than 466 feet to any property or division line. This plan will prevent the drilling of an excessive number of wells, and will also allot each well with a large drainage area that should result in a healthy producing condition with each well having a sufficient gas pressure and oil supply to provide for a long flow under the terms fixing the amount of the gas-oil ratio.

The well spacing plan has been carried further by requiring a deviation test or survey to be made in each well, so that each will be certain to remain safely within its surface producing unit. The straight hole drilling practices established by the Commission are elaborate and carefully planned, providing for a maximum deviation of not more than five degrees from vertical when the well spacing is 20 acres or more, four degrees where the well spacing is 10 acres and less than 20. The maximum deviation shall not exceed three degrees from the vertical when the well spacing is less than 10 acres per well. Surveys shall be spaced at intervals not greater than every 500 feet of hole, with the first point of survey to be made not lower than 1500 feet. This program practically agrees with the generally accepted figures that no greater deviation can be safely permitted in drilling which at any given depth would eventually displace the bottom of the hole more than half the distance between offset wells. This plan will also make pumping a much more easy problem when that stage is reached.

During the past four years or more we have heard much of unitization, and while the Conroe order on unitization does not apply to the entire field, it nevertheless is a step in this direction, as it provides for the unitization of all tracts of less than 20 acres, by combining them with other small or adjacent large tracts. All units in the pool are to be pooled in such a way as to constitute units of 20 acres or approximately that number.

With the forementioned engineering factors clearly and firmly set out in the order, the field is assured a wonderful background for establishing efficient production, but at the same time the Commission's order provides other operating details to safeguard any dangers from wild wells and migration of upper waters into the producing sands.

All casing, whether new or reconditioned, must be tested to 2000 pounds per square inch pressure. It may be tested by pump pressure, providing the mud-laden fluid in the hole is replaced with clear water and a pump pressure of at least 2000 pounds per square inch is applied. If at the end of 30 minutes the pressure shows a drop of 150 pounds or more, the casing will be condemned. After running this tested casing it must set six hours after bailing and before drilling the plug. If the fluid level should show a rise of 50 feet or more at the end of the specified time, a second period of equal time will be used for testing, and should it not measure up to standards on this test it will be condemned.

Christmas tree fittings or well head connections must also be tested to at least 2000 pounds per square inch. Any well showing pressure on the bradenhead, or leaking oil or gas between the surface casing and the oil string will be killed by pumping water through the tubing head, and should the pressure gauge on the bradenhead reflect the applied pressure, the casing shall be condemned and a new oil string must be run and cemented. Blow-out preventers, control head and other connections for keeping the well under control at all times are to be installed as soon as surface casing is set. The position of the oil horizon is to be determined by coring and the producing string is to be cemented not more than 50 feet above the top of the sand.

Welding of Oil Carrying Lines

By N. E. WAGNER

THE purpose of this article is to furnish for general consideration the details of pipe line maintenance where welding is involved.

Factors such as the condition of pipe, the length of the section or sections of especially defective pipe and operating conditions or necessities govern, to a certain extent, the proper method to pursue.

Where pipe is especially bad and the section in such a condition is of considerable length it may be considered practical by the operator to displace the oil with water, cut out the old section and lay in a new one. This may be done without great loss of time, for the new section is first laid parallel to the one to be removed and is welded ready to be tied in when the old section is cut loose. The method to adopt is governed in some respects by the length of time during which the line may be out of service.

For general maintenance the arc welding process is now employed to facilitate the progress of repairs. This process provides a means of making necessary repairs while the line is in service.

Work of this nature being confined to field operations requires the gasoline motor driven direct current generator, both the gasoline motor and generator being of sufficient capacity to promote production. There are two types of welding units employed on this work. One consists of the gasoline engine driven model mounted on one base, which unit in turn is mounted either on truck bed or on four-wheel trailer for transportation along the pipe line system. The other type consists of a welding generator mounted on standard makes of motor trucks and driven by the truck motor. It is not the intent of the writer to enter into a discussion concerning either of the two mentioned types of units. It is sufficient to state that the selection of proper equipment of standard and dependable manufacture is, of course, most important.

As with any other process of pipe line welding, items of speed, fusion, tensil strength and ductility of the weld are most important factors and the selection of electrodes should be considered accordingly.

Maintenance work, for the most part, consists of welding pit holes, leaky collars (if screwed line) welding on collar sleeves, small and large patches and in some cases welding on complete half soles or even completely jacketing the pipe. The proper patching application depends, of course, upon the condition of the pipe line in service.

Pipe sleeves, patches and half soles are all made from pipe, which is generally on hand at the operator's pipe yards. When starting repairs on lines in service, cut off half portions of this pipe for use as patches, sleeves or half soles, as required. After repair work has been started a station or shop welder can keep repair gang supplied with patching material by diverting a portion of his day's work to cutting suitable material. In some instances it has been practical to take such pipe out on the line with the repair gang and cut patches as required. For this type of patch materials the same size pipe is used as that which is in the line to be repaired. If repairing an eight-inch line the slab is cut from eight-inch pipe a little past center, then placed over a joint of eight-inch in the line and sledged so that it will drop over the place to be repaired, clamped up, tacked and the welding process started. If the slab or half sole is long, simple "U" bolts and cross bars are used to pull it into place. If a short slab is to be used the quickest method is to throw a chain around the patch, drawing it up with a small car jack, tacking it, releasing the jack, and then proceeding with the welding.

A systematic procedure for cutting pipe will furnish covering for a maximum footage of pipe line and minimize the amount of pipe required, as well as requiring a minimum amount of welding. This is particularly exemplified where it may be necessary to completely house or jacket two joints of pipe eight inches in diameter. It must be remembered that in jacketing a joint of eight-inch pipe it is necessary to cut or split the jacket-pipe past center in order to enclose the joint, regardless of the method of installation; when it is recalled that for economy it is deemed advisable to use pipe for this purpose which is the same size as the pipe under repair. For example, by taking three joints of pipe and splitting two of them lengthwise at a certain point past center, and one through center, jackets for two joints can be procured with but two pieces left over. These pieces may be used for half soles or patches. Also when pipe is so cut and used for jacketing, the half cut portion is placed on top of line pipe with the bottom portion of the cut piece more than half placed underneath the line pipe and drawn up so that it slightly overlaps the half cut section above. This affords the making of what might be termed a shelf weld and can be quickly completed and offers a good welded seam. However, if the pipe jackets were made from such pipe, all split longitudinally in such a manner as to make a butt weld necessary, it would require four joints of jacket pipe to cover two joints of line pipe with four pieces left over for other use. In addition the butt weld is more difficult to make in field work than is the shelf weld and after one longitudinal seam is jacketed it is necessary to turn the jacket, for butt welding as a general rule, in order to make speed in field welding of long seams, requires working on top as much as possible.

N. E. WAGNER, *for years in charge of welding for the Prairie Pipe Line Company, has pioneered in pipe line welding, and has been partly responsible for numerous developments of welding equipment and methods. He has been conspicuous in the development of methods for salvaging and reconditioning old lines by this process.*

Where there are but a few individual pit holes they can be quickly filled. When pits are deep and there is any possibility of breaking through the pipe with the arc a small metal disc, cut from any pipe, can be used by welding it to cover such pits. Sometimes pits are numerous but are so confined that they cover but a small space on the line so that an almost square patch can be used to cover any number of such spots. If there are many pits covering considerable space over a joint of joints of pipe it is best to weld on a long slab or half sole.

When the pipe at collars or couplings (if screwed line) is not in a very bad condition and only a minor showing of leakage is in evidence, both sides of the collar can be welded with a very good repair job. However, when collar conditions are bad, especially where they have been caulked with hand tools or numerous pits are close to the collar, it is neces-

sary to install a collar sleeve. Some operators have collar sleeves made at the shop so they are swaged out to fit over the collar itself. Other operators make up sleeves in the field in the following manner: On six-inch pipe the collar sleeve is made from eight-inch pipe, cut in the middle, and both halves placed over the collar, a longitudinal weld made, after which heat is applied to both ends and they are belled to the pipe before making circumferential welds; on eight-inch lines the collar sleeves are made from 10-inch pipe in the same manner as described above; on 12-inch pipe the collar sleeves are made of 12-inch, cut a little past center, with the two pieces thus cut forced over the collar and welded accordingly. The next larger size standard pipe than the pipe in the line is generally the most practical for use as collar sleeves and is more adaptable for this purpose, but for 12-inch pipe it is considered more economical to use 12-inch collar sleeves, and this is satisfactory so far as the purpose of the sleeve is concerned when it is field made.

The arc welding process does not require that the line be emptied and therefore work can be continued without displacing the oil and with the line in service, either under pressure or standing full of oil. Hence, the service of the line is not necessarily lost while repairs are in progress. Due caution is expected of the operator when welding pit holes so as not to burn through pipe or maintain arc for undue length of time at one spot, as this might cause the generation of excessive heat. The heat from the arc being more or less local and the weld so instantaneous proper operation eliminates possibility of danger. It is considered best to either have the line full of oil or entirely clean, with oil displaced with water, as a line partly full may have collected gas pockets that should be avoided in oil lines. When welding patches, sleeves or half soles there is hardly any possibility of burning through, for the shoulder or welding edge runs along the surface of the solid pipe wall of the line in service. If there is a leak showing a spray of oil, a cardboard gasket is placed over the hole and the patch drawn over it to shut off the oil until welding can be accomplished.

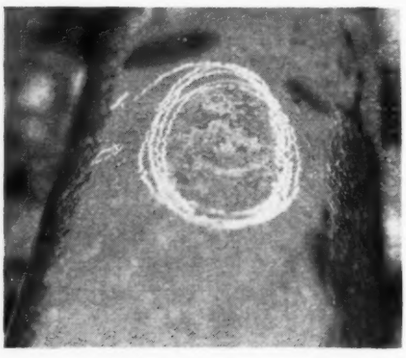
The arc welding process is also adaptable for the installation of branch connections to a line in service. Such installations can be accomplished in several ways. One is to weld a nipple of desired diameter to the pipe line in service, hang a gate valve and open the line with a tapping tool through the gate valve. Another is to use a diamond point hand tool and cut a circle, of smaller diameter than the nipple, almost through the line pipe. The nipple and hand gate valve are then welded on, after which the partly cut out circle is knocked out by means of a bar passed through the gate valve. Still another way is to cut a slab of half circle shape from a piece of pipe in the yard stock. A hole is cut in the slab for opening, with a nipple then welded to the slab over the hole. The slab with the nipple welded to it can then be welded to the pipe line and the gate valve installed. By this last method the line can be opened either with a tapping tool or by knocking out the circle which has been cut with a diamond point prior to welding on the slab.

Corroded Oil Line with "half soles" on bottom

Under the old practice of making repairs to pipe lines, it was customary to displace oil, uncover line, raise and clean line and then cut it in sections, turning it for inspection and repairs. In a number of cases long sections of line were thus taken out of service and after such an expensive procedure, it would be found that a good portion of the long sections did not require repairs, but because of the method involved it was necessary to raise this pipe along with the defective sections.

By the new method of welding only that portion of the line which is actually in need of repairs is disturbed and in so doing it is only necessary to uncover the line at a particular location, loosen dirt on the sides of the pipe and block up in the ditch or dig out under the pipe sufficiently for inspection, cleaning and installation of patches or slabs for welding. Where leaks are spotted it is only necessary to uncover the line each way from the leak, if necessary, until pipe in good condition is found, and then make the needed repairs to the defective portion of the pipe. When sudden leaks occur and a welder is not instantly available all that is necessary is the installing of a temporary clamp over the leak, which will hold until a welder can reach the location and make permanent repairs.

While the details of this article pertain to the maintenance of oil carrying lines the application is also adaptable to lines carrying other substances with a proper procedure suitable to govern factors of safety, operation, etc., according to the nature and use of other classes of pipe lines.



Left: Badly pitted spot in a section of line pipe

Right: Welder strengthening a bad spot with an acetylene spot weld

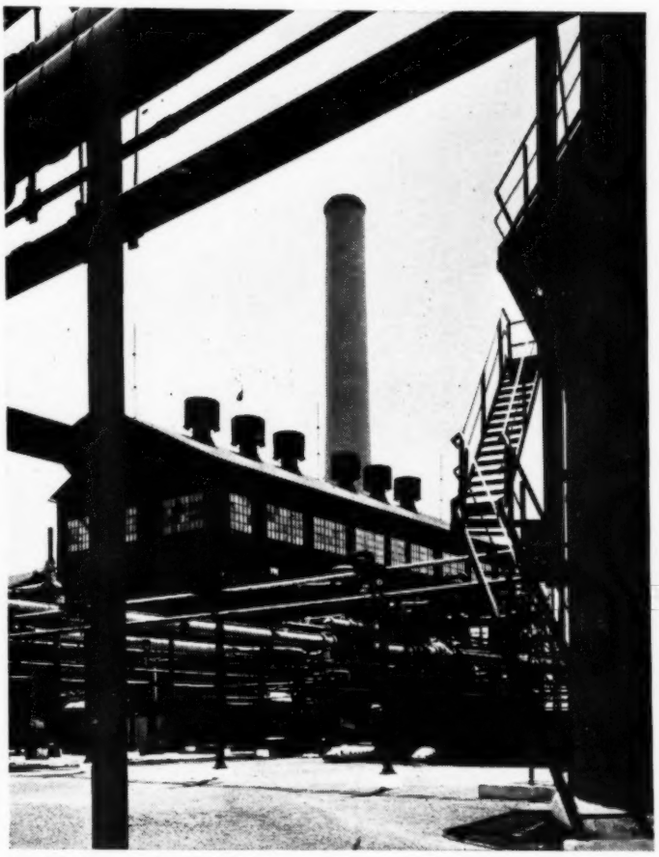
The Manufacture of Hydrogenated Petroleum Products

By F. R. STALEY

Bayway Plant Has Run Steadily for One Year

HYDROGENATED motor oil is now being marketed throughout the eastern half of the United States, from Maine to Louisiana. This motor oil possesses the following qualities: A high viscosity index, winter fluidity, low carbon residue, low consumption, and long life.

Hydrogenated petroleum products are manufactured in a plant of the Standard Oil Company of New Jersey, located at Bayway, N. J., and a plant at Baton Rouge, La., owned by the Standard Oil Company of Louisiana. In addition to the motor oils the hydrogenated line includes solvents for use in the paint, varnish, lacquer, soap and textile industries; a safety fuel for use in aircraft and motor boats, which will not catch fire accidentally under normal temperature conditions; a special aviation oil, and a substitute for benzol which has the blending characteristics of a 110-octane number naphtha, or higher than pure iso-octane. In addition to these products a superior kerosene has also been produced.



View of the Hydrogen Plant framed in a maze of overhead piping

The history of hydrogenation dates back prior to 1912. The work was started by a Doctor Haber and was perfected by Doctor Bosch of Heidelberg, Germany. It was found that by combining hydrogen under certain conditions with nitrogen from the air, nitrates for the manufacture of fertilizers and explosives at least equal to the natural product then imported from Chile, could be produced. About the same time another German, Doctor Bergius, was bending his efforts toward combining hydrogen and coal by much the same methods, to form liquid hydrocarbons such as gasoline and oil.

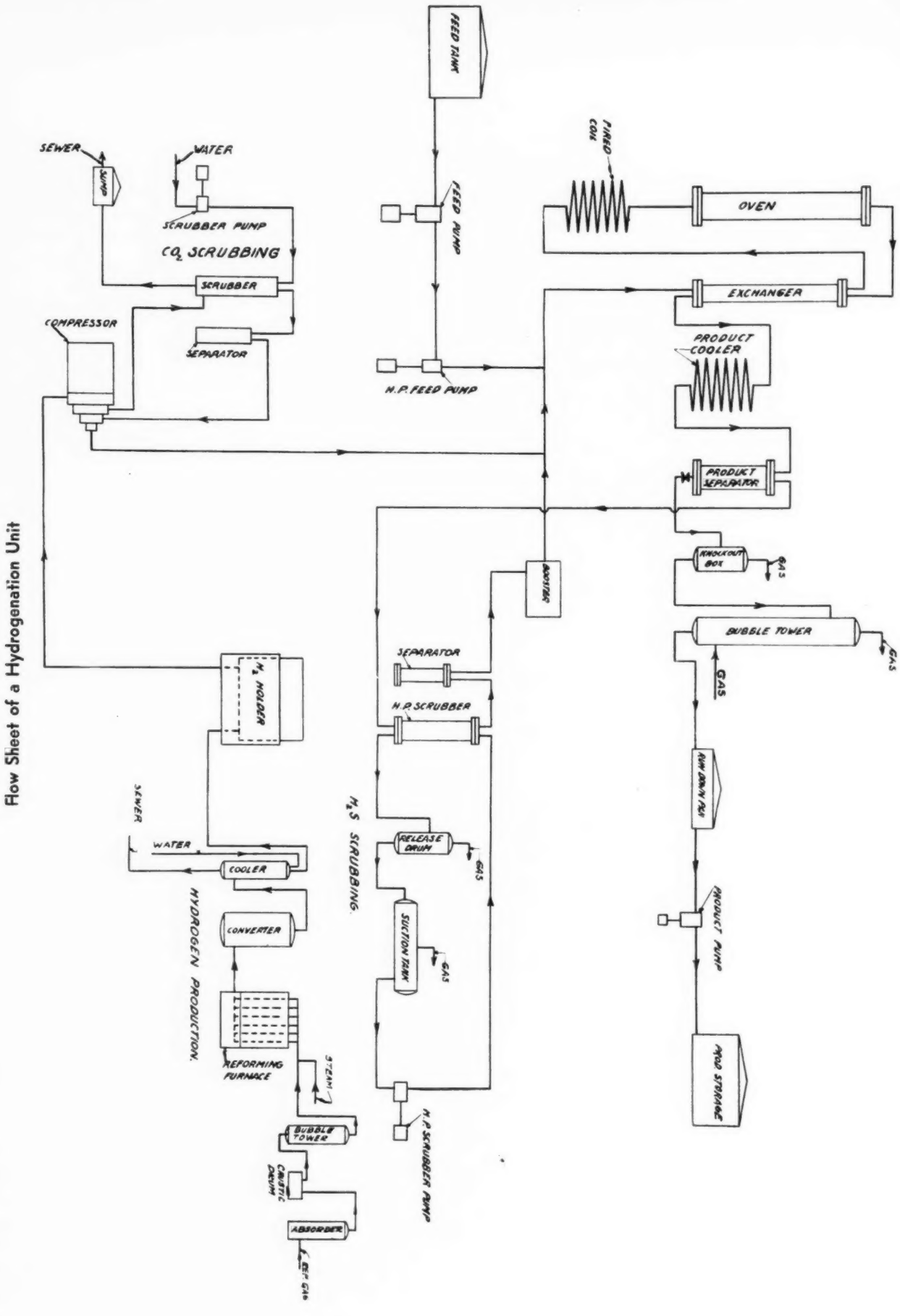
In 1926 developments had progressed sufficiently to attract the attention of the Standard Oil Company of New Jersey, and the following year the company signed an agreement with the I. G. Farbenindustrie Aktiengesellschaft for mutual development of the process. A hundred barrel experimental plant was built at Baton Rouge, La., and for two years the company's scientists worked on the problem of applying the process to petroleum.

In 1929 construction was started on the first plant especially built for oil hydrogenation at Bayway, New Jersey. This was followed by a similar plant at Baton Rouge. For two years products were turned out under commercial operating conditions and innumerable tests run to determine their cost and how they might be improved. At the present time, hydrogenated products are ready to go on the market. The hydrogenation plant at Bayway consists of two units, each housed in a separate concrete stall. Each unit has a daily charging capacity of from 2500 to 5000 barrels, depending upon the type of charging stock and products being manufactured. In the production of lubricating oil the capacity ranges from 2500 to 3500 barrels a day, varying with the charging stock. When making antiknock gasoline the charging capacity is approximately 5000 barrels daily. Production of antiknock gasoline takes place in the vapor phase at a temperature around 1000 degrees F. To manufacture hydrogenated lubricating oils, the oil is charged into the reaction towers in the liquid state at a temperature approximating 800 degrees F.

Construction Features

The largest forgings of alloy steel ever fabricated in the United States are used for the reaction chambers, which are 40 feet high. Their inside diameters are each three feet, with specially constructed walls seven inches thick. All piping in the high pressure side of the plant is of unusual thickness. Leak-proof joints are effected by drawing two accurately machined ends together against an alloy steel gasket. Machining is so precise that even when the flange bolts are hand tightened, the joints will withstand the system pressure of 3600 pounds per square inch.

The hydrogen gas holder is fitted with both low and high pressure alarms, which sound in the control room whenever the rise of holder becomes such that there is likelihood of the escape of hydrogen into the atmosphere, or if inward leakage of atmospheric oxygen occurs. The oxygen content of the gas on the high pressure side of the plant is maintained at less than 0.2 per cent by means of a special recorder-alarm device, which is attached to the compressor discharge line. A small representative sample of the gas is continuously passed through the recorder alarm. In this instrument the gas



Flow Sheet of a Hydrogenation Unit

is washed and dried and passed through electrically-heated porcelain tubes containing platinum black catalyst. The tubes are heated to a temperature of about 300 degrees F., at which temperature and in the presence of this catalyst, any oxygen present reacts with the hydrogen to form water. This reaction is highly exothermic. An accurate thermocouple pyrometer records the temperatures in the furnace and any increase in temperature due to the formation of water is immediately recorded on a scale graduated in per cent of oxygen. The electrical energy generated in the thermocouple by the heat of reaction actuates an electric alarm, which sounds in the control house. Whenever the oxygen content of the gas rises above 0.2 per cent, the high pressure equipment is immediately shut down and the cause of the trouble investigated.

Hydrogen

Hydrogen may be prepared in a number of ways. At Bayway it is derived from cracking coil gas. At present about two million cubic feet are manufactured daily, although the plant is capable of generating nearly seven million cubic feet per day. The gas from the cracking units is first given a preliminary scrubbing at the gasoline recovery plant. It is then treated in a Koppers treating system, and washed with caustic soda preparation for the removal of sulphur constituents. It is then ready for the reforming furnace. Here the gas, mixed with steam, passes through tubes packed with catalyst and heated to a temperature of about 1800 degrees F. under 15 pounds pressure. In the reaction hydrogen and carbon monoxide are produced. It is possible to make about one-half the steam required in the process from the flue gas of the reforming furnaces by means of a waste heat boiler.

More steam is added to the hydrogen and carbon monoxide mixture, and in the second phase of the process, known as conversion, hydrogen and carbon dioxide are made. The gases pass through catalyst filled trays at 850 degrees F. The gaseous mixture leaving the converter is composed of about 79 per cent hydrogen, 20 per cent carbon dioxide, and 1 per cent hydrocarbons and other gases.

The gases are cooled by passing "counter-currently" to water in a coke packed cooling tower. The cooling water is circulated through an atmospheric cooler and then recycled. From the coolers the gases go to storage in a gas holder. The gaseous mixture is taken from the holder, through a moisture trap and introduced into the compressor system. The gas is raised to the hydrogenation pressure of 3600 pounds per square inch in four stages. Between the second and third stages it is stripped of its carbon dioxide. The compressor house contains three electric and two steam driven units.

The gaseous mixture is passed through a packed scrubbing tower "counter-current" to sea water at a pressure of 240 pounds per square inch. The carbon dioxide is dissolved in the water, and the percentage in the gas decreases from 20 to less than 0.6 per cent. The gas is further compressed in the third and fourth stages. Gas is supplied by the compressor system to the hydrogenation equipment at the rate necessary to maintain the desired reaction pressure.

The feed stock is pumped to high pressure feed pumps, in which the pressure is raised to 3600 pounds per square inch. The charging stock and hydrogen, both at the same pressure, are finally brought together through a "T" connection and are then ready for the final step.

The oil-hydrogen mixture is first preheated in heat exchangers located inside the concrete stalls, in which they pass "counter-current" to the hot hydrogenated products from the reaction chambers. The oil-gas mixture is then raised to the reaction temperature in a gas fired coil. In the reaction chambers (of which there are four in each unit) the mixture passes upward through the packed catalyst at the hydrogenation temperature and pressure, which causes the oil and some of the hydrogen to unite. The reaction is exothermic, so that relatively little heat is needed for the fired coil.

The reaction products pass out the top of the chambers and are led through the heat exchangers and a cooler to a release drum. Here the gas and liquid are separated, the liquid being released into a low pressure separator maintained at a pressure of around 200 pounds. Any gas remaining at this stage is drawn off and sent to the burning line, while the liquid products are scrubbed to remove hydrogen sulphide.

Gases from the high pressure release drum are led to an oil scrubber before being recirculated. Hydrogen has a tendency to become contaminated with unconverted hydrocarbons in the process, and so it is necessary from time to time to wash these constituents out with oil. Gas coming from the top of the scrubber passes through a separator, and then goes to a booster pump, where its pressure is raised to that maintained in the system before being returned to the hydrogenation equipment.

The Bayway plant has run continuously night and day for an entire year without interruption, and the same catalyst has been used without breaking down.

Gohr and Russel have outlined the technological developments in the hydrogenation process during the past two years.[1] New methods of catalyst manufacture have made it possible to obtain greater throughput as well as greater yields and longer catalyst life.

More than 150 stocks have been studied under various conditions of catalyst temperature, time of contact, hydrogen pressure, etc. As a result it has become possible to predict the type of feed stocks necessary for maximum yield of a given quality product as well as to determine the required operating conditions. Information has been obtained which permits operation under conditions for maximum catalyst life and activity.

The chemical reactions alter their direction and extent according to the conditions of the hydrogenation treatment and the nature of the catalyst employed. Three characteristic reactions remain unaltered in direction, however, changing only in extent. The first of these reactions is a species of purification, called by Ellis, "hydrocarbonization," and is defined as the tendency to eliminate from the liquid product everything save hydrocarbons. In other words, nitrogen, oxygen and sulphur, present in natural hydrocarbons, are preferently attacked by the hydrogen and removed from the reaction zone as the corresponding gaseous hydrides. The second characteristic reaction is that of stabilization. The hydrocarbons that emerge from the hydrogenation process are by their very nature chemically stable. The third characteristic reaction is that of homogenizing, the tendency to produce a mixture of a more homogeneous nature than the raw material by preferential reformation of the more complex molecules. A hydrogenated oil is, in general, characterized by relative freedom from complex structures of the asphaltic and resinous types, and relative freedom from the more heavy and complex viscous fractions. These three characteristic properties, however, are secondary rather than primary in character. The most important properties are those resulting from the chemical structure of the prevailing type of hydrocarbon present in the mixture. Paraffinic types are advantageous for lubricants and burning oils, while naphthenic and aromatic forms are preferred for gasoline. The hydrogenation process offers particular possibilities, since it affords a means of reforming the molecular structure of petroleum hydrocarbons along directed lines, thereby obtaining products of the paraffinic or naphthenic type substantially regardless of crude source. The hydrogenated products, because of their characteristic purity, stability and homogenous nature, are to a large extent free from the objectionable properties inherent to natural paraffinic or naphthenic products.

[1]Jour. Inst. Pet. Technologists, July, 1932.

Wildcat Rotary Has Ai C
V-Type Engines i Su

By K. SCL

Ben Wofford, President, Sovereign Oil Corporation, and President Wofford Drilling Company

THIS MONTH'S FRONT COVER

. . shows the Sovereign Oil Corporation's No. 1 Flower, which is described in the accompanying article. It is one of the most interesting wildcats in Oklahoma, both as a test and as exemplifying modern drilling equipment and practices.

ROTARY drilling power equipment of the most advanced mechanical design is being used on a wildcat well, the Sovereign Oil Corporation's No. 1 Flower, in Section 14-Twp. 12 N. R. 3 E, in the southwest part of Lincoln County, near Meeker, Okla. This is a community test well in a 640-acre block of leases assembled by Blake Dirickson, now head of the land department of the Sovereign Oil Corporation. The Sovereign Oil Corporation, with Ben Wofford of the Wofford Drilling Company as president and H. A. Scott as vice-president, is composed of several oil companies and independent producers prominent in the Mid-Continent.

It is planned to drill with the rotary to the top of the Wilcox sand, expected at a depth of approximately 5,500 feet, and to set a string of 8¼-inch casing before drilling in with standard cable tools. On October 8, the well had reached a depth of 4,500 feet, and was drilling in loose sand and shale.

Though it is being watched with keen interest by oil men of Oklahoma as a prospect well, it is also the center of interest because of the lay-out of mechanical equipment used in drilling.

Power for this rotary drilling unit is supplied by four 250-h.p. Le Roi V-type, 8-cylinder valve-in-head engines, two for the drawworks and two for the mud pumps. These engines can operate with either gasoline or natural gas as fuel.

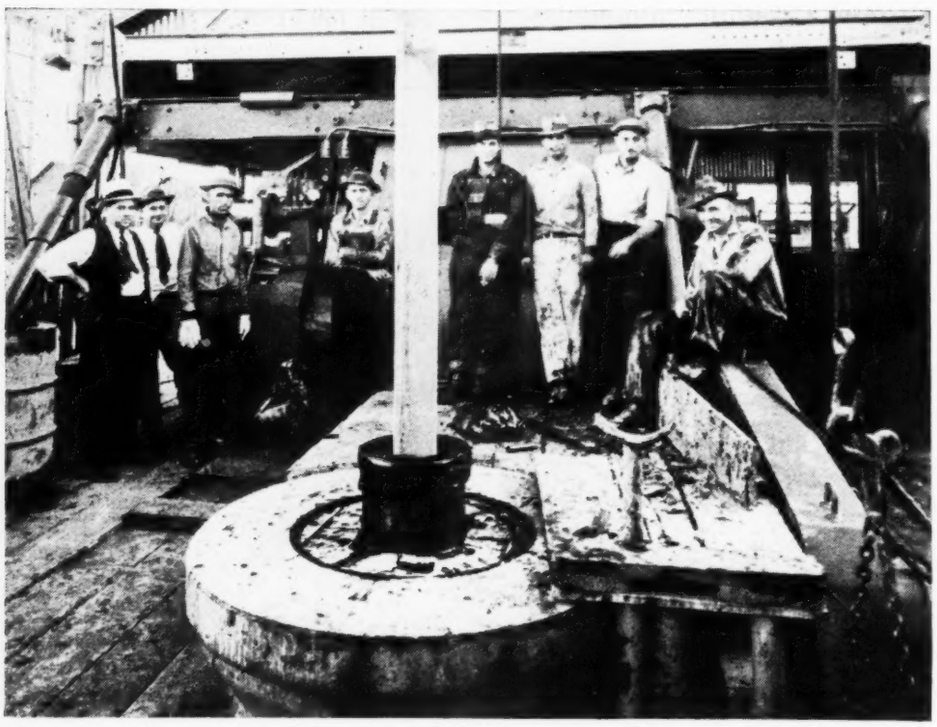
Power is transmitted from the engines to the drawworks lineshaft by high-speed roller chains through reversible reduction gears. Also the two engines on the drawworks are connected together by high-speed roller chains.

One of the distinctive features of the drilling outfit is the air-operated controls. The drawworks engines are equipped with air compressors for operating self-starters that are controlled from the driller's position on the derrick floor. There are also air-operated controls on the reversible reduction gears with which the drawworks engines are equipped. This air-operated reverse lever also is operated from the driller's position on the derrick floor through a combination throttle and reverse lever much the same as those in common use on air-operated steam rigs. Twin Disc clutches complete the air-operated control equipment.

Two engines are hooked up to two 7¾-inch by 18-inch Lucey power slush pumps and transmit power by means of a high speed roller chain drive through a two-speed gear box. These engines, like the engines on the drawworks, are also connected by a high-speed roller chain. The pinion shafts of the mud pumps are connected direct to the drive-shaft of the gear box by means of flexible couplings, designed so that either pump can be disconnected merely by removing the chain that encircles the sprocket-like halves of the coupling.

A heavy Lucey drawworks and rotary table comprise the remainder of the rotary equipment proper.

The details of the power drive for this drilling unit were worked out for the Lucey Products Cor-



One of the drilling crews on the Meeker well, Flower No. 1, of the Sovereign Oil Corporation.

Operated Controls and Successful Use

By K. SCLATER

poration, distributors for Lucey rotary drilling equipment, by engineers of the Le Roi Engine Company of Milwaukee, the Nordberg Compressor Company of Milwaukee, and Wheland Company of Chattanooga.

All the power equipment is mounted on a sturdy foundation of structural steel.

A Lee C. Moore 122-foot Champion steel derrick is being used on the well. Every piece of equipment on the well is of the heaviest and latest type. A 3-inch high pressure Isco rotary hose is used between the pumps and the drill stem. The drill pipe is 6-inch 25-pound seamless steel manufactured by the Pittsburgh Steel Products, and equipped with Hughes tool joints and lock bits. The rotary drilling line is a 1⅛-inch Wickwire Spencer steel cable.

As can be seen on the illustration on the front cover, the drawworks and pumps with their prime movers are housed in substantial Braden steel buildings.

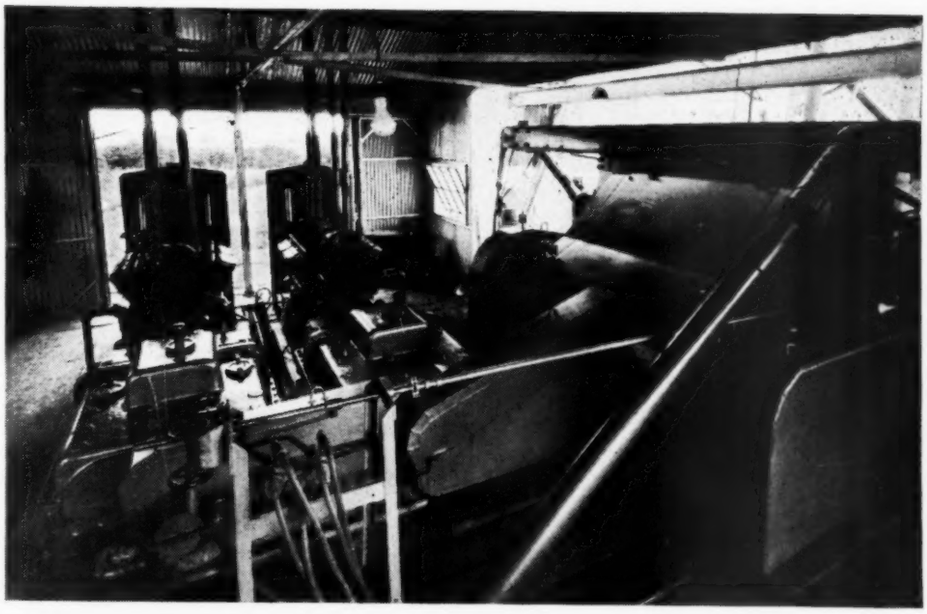
The engines are running on natural gas and the total average volume of fuel consumed is from 50,000 to 60,000 cubic feet per day.

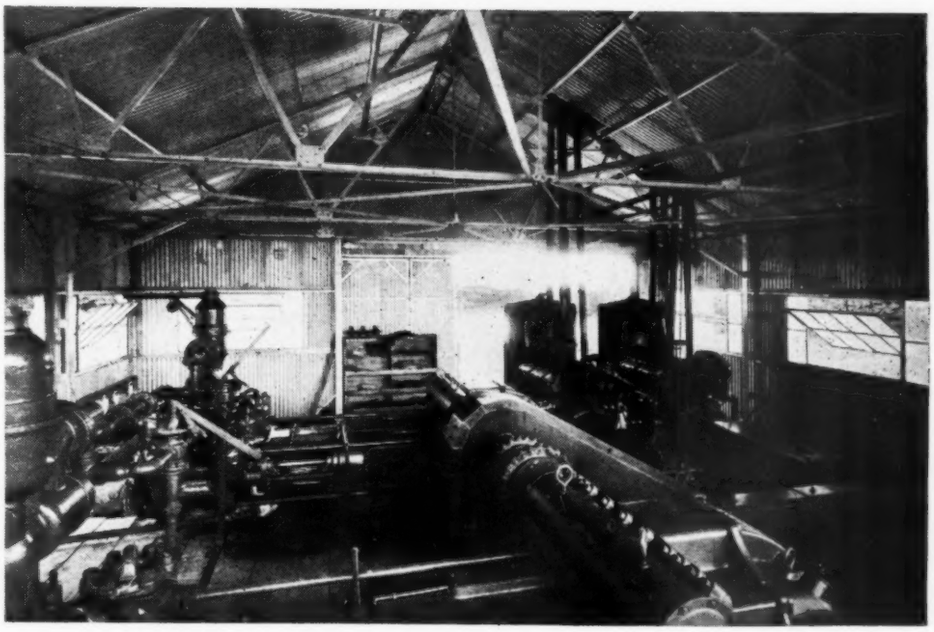
In designing this equipment the engineers have kept in mind flexibility of control approaching that of drilling equipment already in use. By applying air-operated controls to the engines, the reversible reduction gears, and the clutches, the desired degree of flexibility of control and regulation has been achieved. The air-operated method of control and the success that has attended its use on this well have created exceptional interest.

A 12-inch by 12-inch twin Oil-Well steam engine with enclosed oil bath has already been set for drilling in with cable tools. At this writing the boiler had not yet been placed at the well.

George A. Campbell, maintenance engineer for the Sovereign Oil Corporation, to whom is due much of the credit for the smooth running of the mechanical equipment, is in charge of the power installation at the well.

H. A. Scott, Vice-President, Sovereign Oil Corporation and Vice-President Wofford Drilling Company





Middle view, showing the reversible reduction gears and power transmission between the engines and the draw works. Note the air lines in the left foreground.

Lower view shows the two-speed gear and power transmission to the mud pumps.

Commercial Oil Production at 9710 Feet—The Deepest Producer in the World

By WALLACE A. SAWDON, Petroleum Engineer

Associated Betters Own Record by 900 Feet

BEATING its own previous record in the same field, Associated Oil Company has completed the deepest producing well in the world with its Lloyd 83 in the Ventura Avenue field, California. This well was drilled to 9710 feet and is nearly 900 feet deeper than the preceding record holder, Lloyd 57, which was completed at 8823 feet over a year ago. Of particular importance, however, is the proving of an additional 500 feet of producing zone below that of Lloyd 57, with the new record holder, Lloyd 83, flowing oil and gas from both the same zone as its predecessor and from the new lower zone.

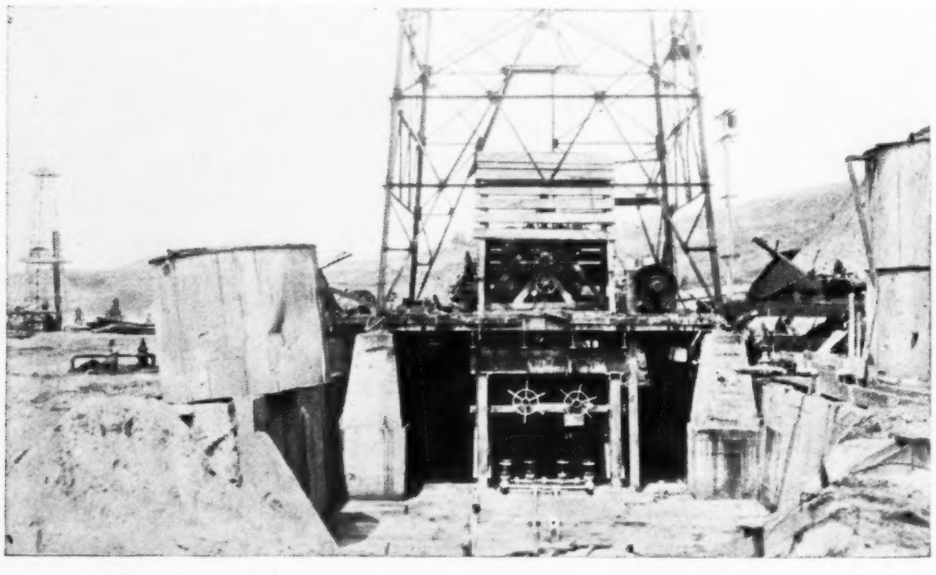
The initial production from Lloyd 83 was about 5000 barrels of 27.2 gravity oil a day. It was cutting slightly, however, and mud was showing with its production; moreover, the pressure was not what had been expected, although a large volume of gas with high pressure had interfered with drilling operations at the lower depths. The flow was killed, therefore, and a perforation washer used from 9700 feet up to 9463 feet. The returns still showed a considerable amount of heavy mud, however, so washing was then continued to 8646 feet. This recompletion work being finished, the well was flowed through beans, and gave a production of 5243 barrels of oil with 3,975,000 feet of gas per day. Both cutting and the presence of mud were also reduced to a minimum.

The new zone below the Lloyd 57 horizon has been tentatively called the "Lloyd 83" zone. The location of the well is about 7000 feet east of the river, where the theoretical apex of the structure is situated. There is every reason to believe that the "Lloyd 83" zone will extend fully that far, and probably continue on the west flank of the structure. Its extent to the north and south cannot be determined at present, but it is probably as great as the other zones immediately above. The production is from the lower Pliocene and strengthens the assumption that oil bearing formations will be encountered down to the top of the Miocene which may not lie very far below the point reached by Lloyd 83.

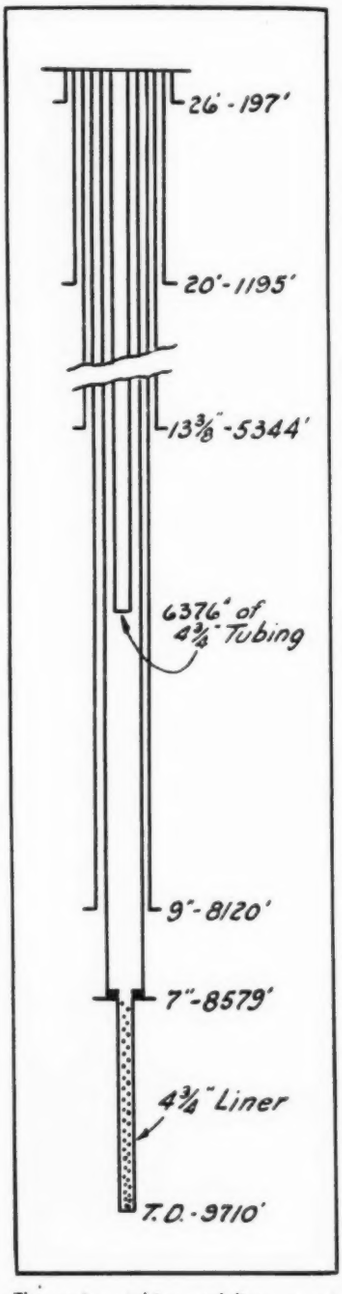
The ease with which this deep well was completed speaks well for the methods developed by the Associated Oil Company for drilling in the Ventura Avenue field. These methods in general are described in a previous number of THE PETROLEUM ENGINEER,[1] and while only a slight amount of special equipment was used on Lloyd 83, the equipment was arranged to give the greatest efficiency in operation. No mechanical difficulties of any extent were encountered but extreme care to prevent any trouble was taken at all times during the drilling of the well.

The well was spudded in on April 19, 1931, with a 29-inch hole, using seven-inch drill pipe to 197 feet, where a string of 26-inch conductor pipe was set. A 25-inch hole was drilled from this depth with six-inch Youngstown drill pipe being used. A string of 20-inch casing was set at 1195 feet, after which a 19-inch hole was carried to 5344

[1] "Completing the World's Deepest Producing Well," *The Petroleum Engineer*, June, 1931.

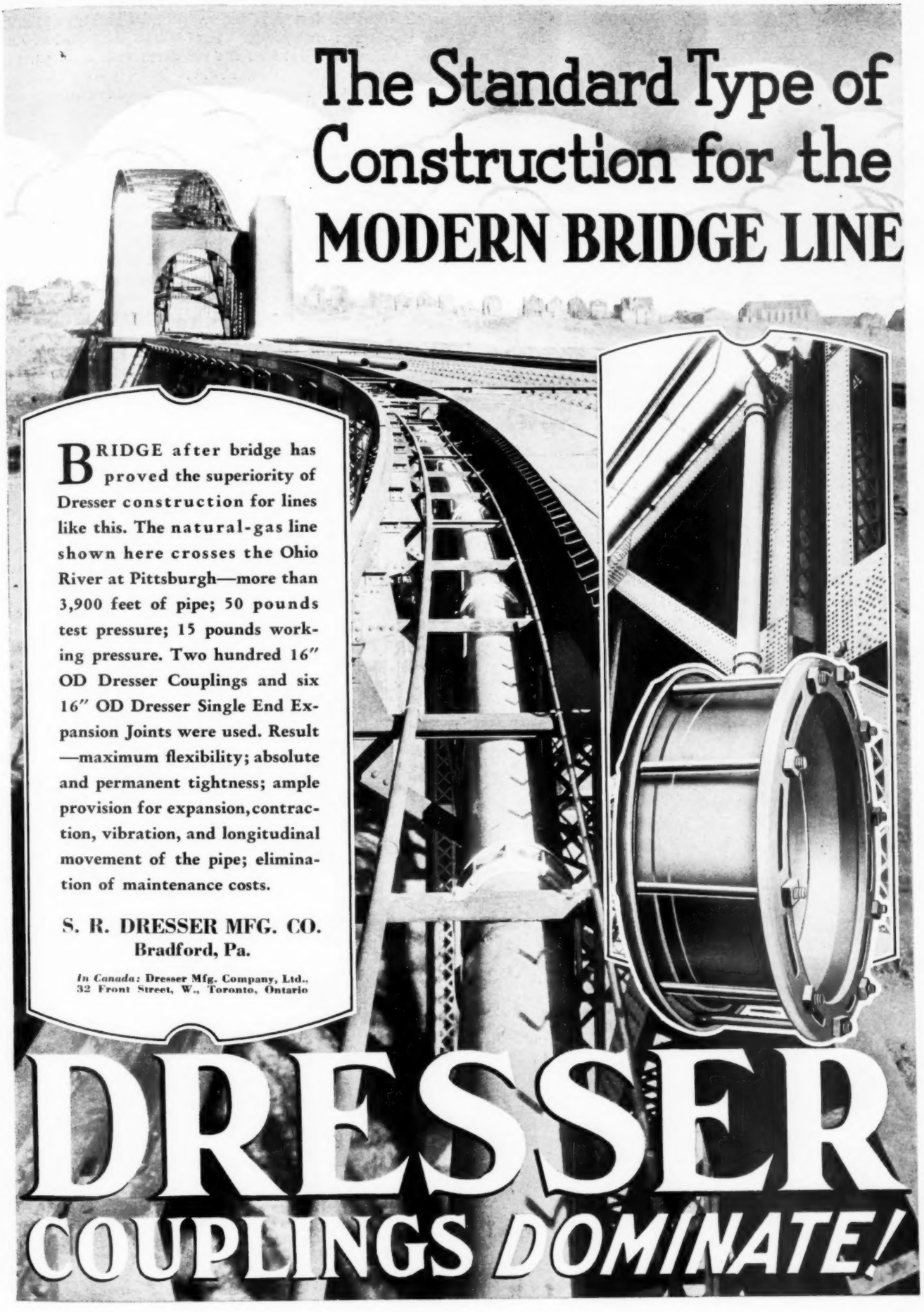


The cellar with the control gate wheels; and above on the derrick floor the high pressure Christmas tree hook-up. Lloyd 83 on production.



The casing, tubing and liner as set in the completed well

The Standard Type of Construction for the MODERN BRIDGE LINE



BRIDGE after bridge has proved the superiority of Dresser construction for lines like this. The natural-gas line shown here crosses the Ohio River at Pittsburgh—more than 3,900 feet of pipe; 50 pounds test pressure; 15 pounds working pressure. Two hundred 16″ OD Dresser Couplings and six 16″ OD Dresser Single End Expansion Joints were used. Result—maximum flexibility; absolute and permanent tightness; ample provision for expansion, contraction, vibration, and longitudinal movement of the pipe; elimination of maintenance costs.

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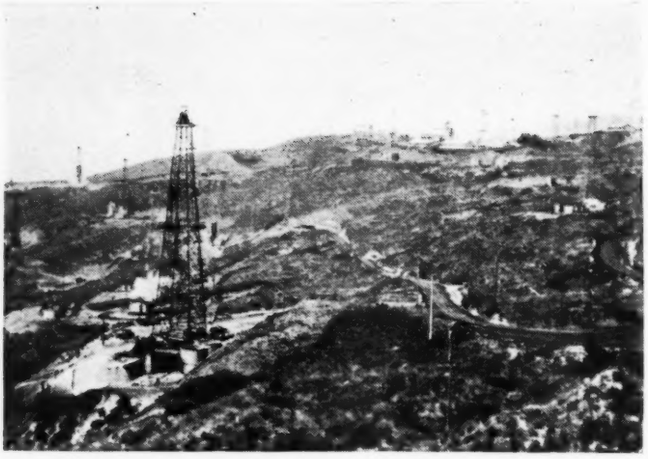


The deepest producing well in the world — Associated Oil Company's Lloyd 83 in the Ventura Avenue Field, California

feet, where another casing string was set and cemented. This string was 13⅜-inch O. D., 61-pound, and served as a protector to the hole while drilling a 12⅜-inch bore with five-inch drill pipe to 8120 feet, at which depth the nine-inch, 45-pound casing string was cemented. A 7⅞-inch hole was then drilled with four-inch pipe to 8579 feet, at which depth a string of seven-inch, 30-pound pipe was set and cemented. All of the casing strings were Grade D, and were products of Youngstown Sheet & Tube Company, Youngstown, Ohio. A six-inch hole was then drilled with three-inch drill pipe to the total depth of 9710 feet. The liner was 1179 feet in length and consisted of 4¾-inch, 21-pound pipe, of which 1089 feet was perforated with 500-mesh screen. A 6376-foot string of 4¾-inch, 16-pound tubing was run into the well to hang 2200 feet above the bottom of the seven-inch string.

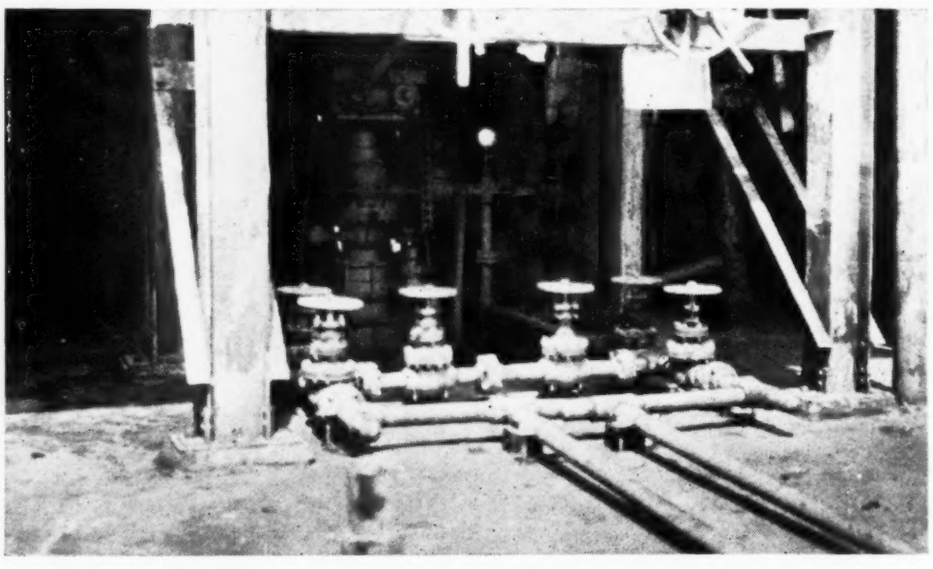
No difficulty arose in cementing the long strings of casing in this well, and the temperatures encountered evidently had little effect on the cement used. It was estimated that the temperature at the bottom did not exceed 200 degrees F., which is less than could be expected in most of the other California fields at that depth.

Heavy equipment was used at the surface and was set in a 136-foot steel derrick. Included in this was a draw works with seven-inch line shaft and compounded brake; at 12 x 12 enclosed type twin-cylinder steam engine and a 10 x 10 twin-cylinder steam engine used as a stand-by; three slush pumps; chain-driven rotary table; 66-inch roller bearing traveling block with 36-inch sheaves; and a roller bearing crown block. A one-inch steel line was used for handling casing.

The mud pumps were placed in the cellar and were three in number. They were 14 x 7¼ x 14 and, due to their position, had a head of about ten feet on the suction end at all times. The maximum pressure reached was approximately 1500 pounds. Circulation caused no trouble, but at the lower depths it was found difficult to get the tools out of the hole without letting the well blow in. The large volume of gas under high pressure would aerate the drilling fluid until it was so thin that the well would start to flow. Heavy mud would then have to be circulated before the pipe could be pulled; and at times it took as long as two days to come out of the hole. Mud weighting materials were used while drilling the lower depths and the mud was kept at about 95 pounds. The same character mud was also used in killing the well during recompletion operations, which were done after the liner had been set.

Drilling at the various depths was done with fish-tail, special and rock bits. Cores were taken to establish markers throughout the operation with almost continuous coring being done below the bottom of the seven-inch casing and with the last 500 feet in the new zone cored completely. Core recovery was high and valuable data were secured for classification of the lower formations.

Improvements in drilling during the last two years or more have raised the outlook for Ventura Avenue by making it possible to reach these great depths with comparative ease. At the present time the most interesting well under way is the General Petroleum Company's Barnard 15-A, which is headed for the 9700-foot sand. An entire new rotary rig was purchased for this test with the idea of drilling to 10,000 feet or more. The equipment is of the heaviest and latest type obtainable and the derrick is constructed to withstand the greatest strains. This well is quite a distance from Lloyd No. 83 and its success would greatly raise the prospects of the new deep sand underlying a large part of the field. Owing to the size of the various holdings, the number of drilling operations to this deep horizon are expected to be held to a minimum.



The casing heads and the control gate are here easily accessible below the derrick floor

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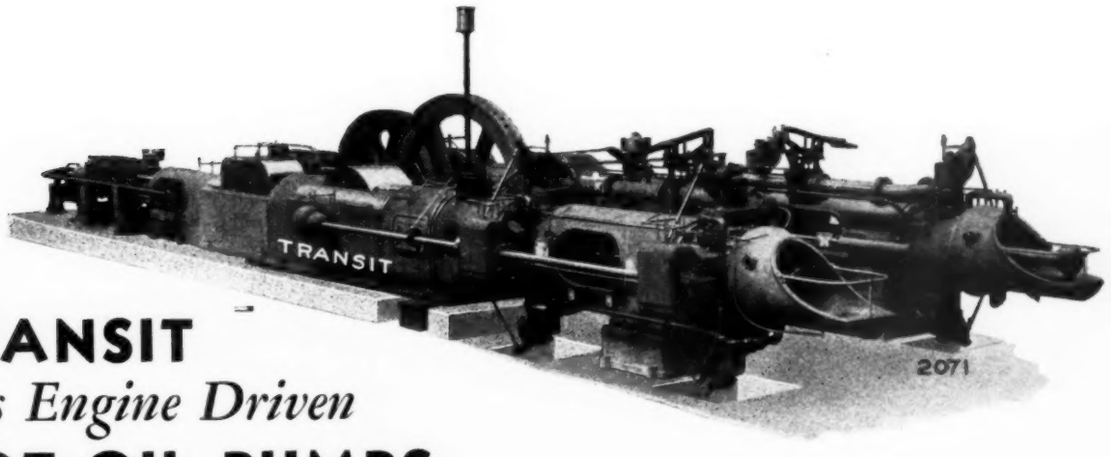

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FIELD PUMPS TOOLS for Pipe Line Construction
GAS ENGINES GAS ENGINE GAS COMPRESSORS

Oklahoma's Latest Discovery Well Drilled With Modern Equipment

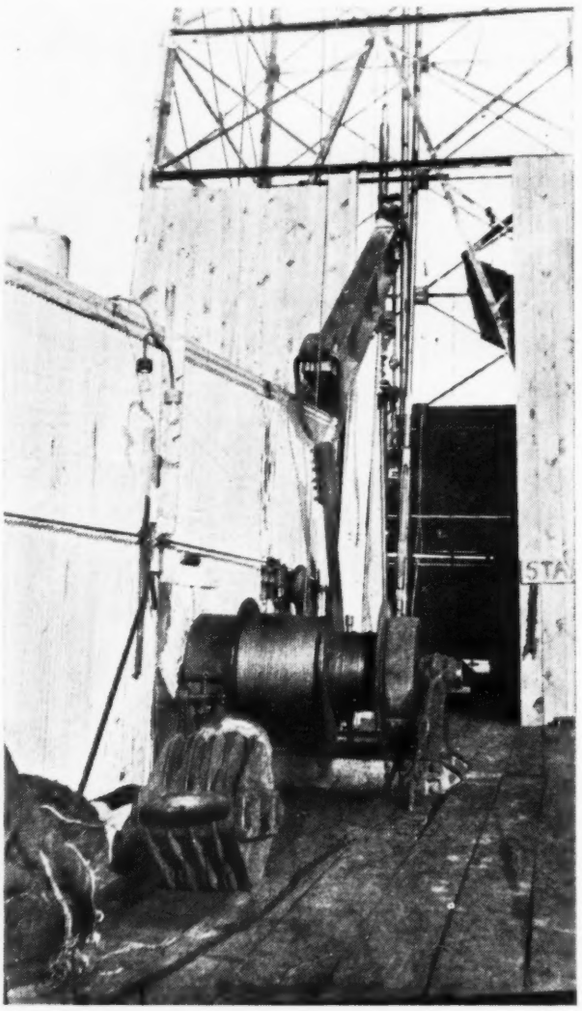
By K. C. SCLATER

ON September 28, 1932, the bringing in of the L. H. Wentz and others' community test well, G. Wolff No. 1, eleven miles southwest of the town of Perry, marked the discovery of a new oil field in Oklahoma; whether or not of major proportions still remains to be determined by further development work. Located in Section 17, 20 N., 2 W., the well is in the approximate center of a block of 2160 acres, consisting of 108 units of twenty acres each, held jointly by eight companies, as follows:

Shell Corporation - - -	37 units
Gypsy Oil Company - -	16 units
Sinclair-Prairie Oil Co. - -	16 units
L. H. Wentz - - - - -	12 units
Carter Oil Company - -	8 units
Phillips Petroleum Co. -	8 units
Twin State Oil Co. - -	8 units
Empire Companies - - -	3 units

Production was found in the Wilcox sand at 5197 feet, the present total depth of the well. The top of the Wilcox sand is believed to have been penetrated at 5178 feet, below which was encountered some very hard green shale. The Wilcox sand was struck again below the shale break at 5196 feet and was drilled into only one foot to 5197 feet. Though but one foot of sand was penetrated below the shale break the well started flowing by heads, causing suspension of drilling operations.

Heading about once every hour, the well flowed for about eighteen minutes at each head through the eight and one-quarter-inch casing. In the first first twenty-four hours the well produced in this manner at an average rate of 1728 barrels oil a day. During the first four hours the average hourly production was reported to be sixty-eight barrels and during the last four hours, eighty barrels, or an average of seventy-two barrels an hour for the first twenty-four hours.



A view of the well, showing the chain-driven sand reel used for drilling in

A bottom-hole pressure of 1065 pounds per square inch was observed on the well at about 5178 feet, when the top of the Wilcox sand above the green shale was penetrated. At the time this pressure reading was taken there was reported to be 3000 feet of fluid in the hole. At this writing no bottom-hole pressures have been taken at the face of the productive part of the sand from 5196 feet to 5197 feet. An analysis of the oil had not yet been made when this article was written; but the gravity of the oil is 44 degrees A.P.I. at 76 degrees F. or 42.7 degrees A.P.I. corrected to 60 degrees F. Pitot-tube measurements show that the initial rate of flow of gas from the well fluctuated between 2,500,000 subic feet and 7,000,000 cubic feet per day.

It is of interest to note that this well was drilled with a Waukesha gasoline-engine-driven rotary outfit to 5077 feet in sixty-three days' actual drilling time. This included the taking of ten cores with a Hughes core bit. Every 250 feet the hole was tested for deviation from the vertical. The maximum deviation, which occurred at a depth of 1250 feet and at 2250 feet, was found to be only two and one-half degrees.

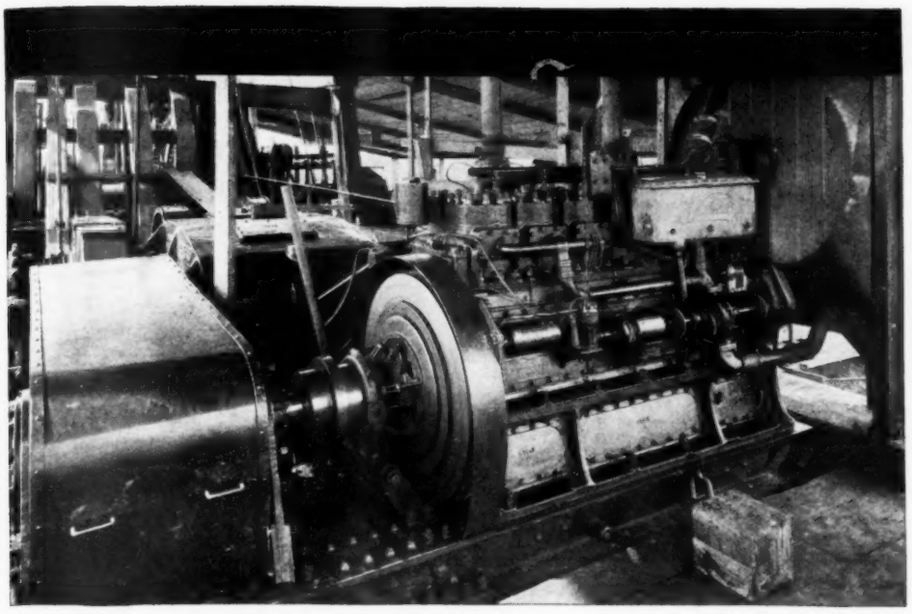
Rigging up on the well was started June 30, 1932, and on July 5, 1932, the well was was spudded in. Surface pipe consisting of 136 feet of 15½-inch 70-pound seamless steel casing was set and cemented with 115 sacks of cement. On September 5, 1932, a string of 8¼-inch 32-pound seamless steel casing was set and cemented at 5069 feet with 1000 sacks of cement.

No serious drilling difficulties were encountered in drilling with the rotary, despite the fact that rock bits were used practically the whole length of the eleven-inch hole. Mud, satisfactory as a drilling fluid, was obtained from the formations drilled through, making it unnecessary to ship in mud to the well.

After landing the 8¼-inch casing the cement was allowed to set ten days before resumption of drilling. During this time the rotary drilling equipment was removed and the well standardized for drilling with cable tools. Save for one fishing job of about six hours' duration, at 5096 feet, resulting from "jumping" a pin on the bit, the well was drilled in without a hitch. Slight shows of oil were observed from 5126 feet on down. When the top of the Wilcox sand was penetrated at 5178 feet oil began to rise in the hole at a reported rate of 200 feet an hour. From 5196 feet to 5197 feet the sand was so productive that the well started to flow while the tools were still in the hole.

Tankage has been erected and a separator has been set at the well since drilling was suspended at 5197 feet. A separator with the necessary connections and six 500-barrel Maloney tanks are now in readiness to handle the production from the well.

Proration regulations issued by the Corporation Commis-



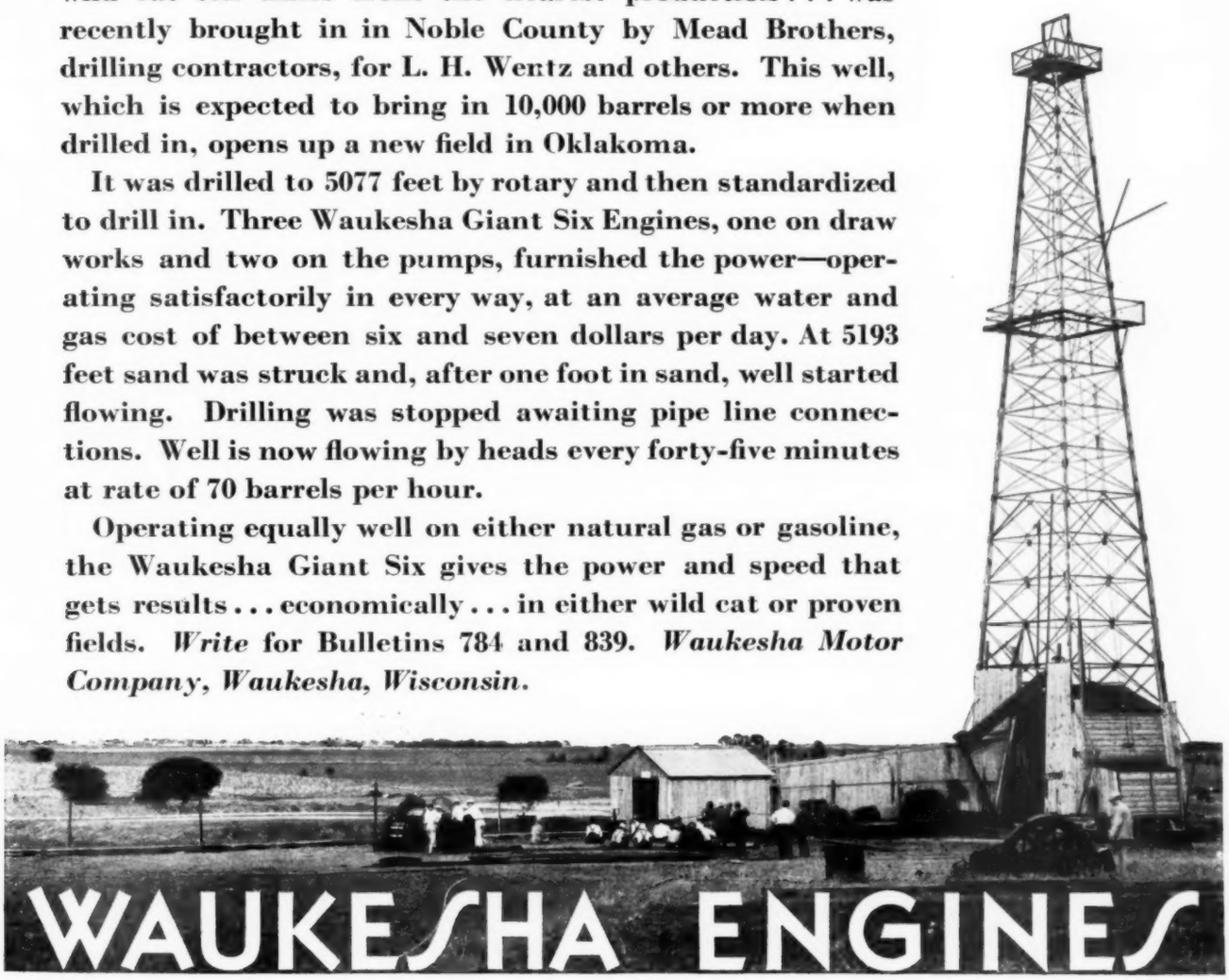
Three Waukesha Giant Sixes . . . one on draw works and two on pumps . . . were used by Mead Bros., drilling contractors, in opening up new field at No. 1 Wolfe, Sec. 17—20—2 W Noble County, Okla., 14 miles southwest of Perry, Okla.

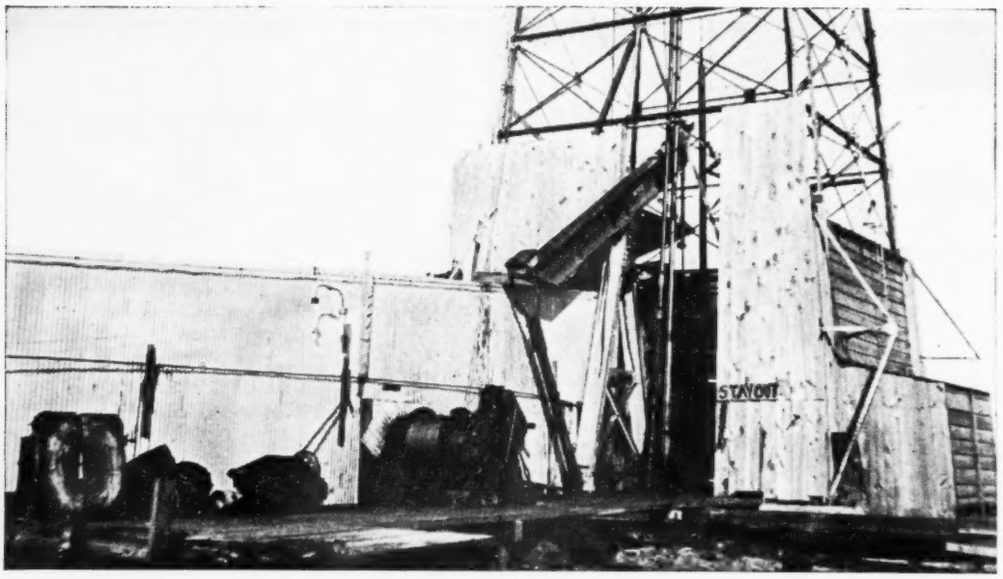
WAUKESHA POWERS NEW FIELD

Oklahoma's first important oil strike in two years...a rank wild cat ten miles from the nearest production . . . was recently brought in in Noble County by Mead Brothers, drilling contractors, for L. H. Wentz and others. This well, which is expected to bring in 10,000 barrels or more when drilled in, opens up a new field in Oklakoma.

It was drilled to 5077 feet by rotary and then standardized to drill in. Three Waukesha Giant Six Engines, one on draw works and two on the pumps, furnished the power—operating satisfactorily in every way, at an average water and gas cost of between six and seven dollars per day. At 5193 feet sand was struck and, after one foot in sand, well started flowing. Drilling was stopped awaiting pipe line connections. Well is now flowing by heads every forty-five minutes at rate of 70 barrels per hour.

Operating equally well on either natural gas or gasoline, the Waukesha Giant Six gives the power and speed that gets results . . . economically . . . in either wild cat or proven fields. *Write* for Bulletins 784 and 839. *Waukesha Motor Company, Waukesha, Wisconsin.*





The L. H. Wentz and Others' G. Wolff No. 1 Perry discovery well after it was standardized

sion of the State of Oklahoma restrict the production of the well to fifty barrels daily. At this writing no pipe line connections for either oil or gas have been run to the well.

Freedom from drilling troubles on this well, it is asserted, has been due to the use of drilling equipment of adequate strength and capacity, and to the skill and experience of the drilling crews. The fact that the prime-movers used were high speed vertical gasoline engines is noteworthy.

Mead Brothers Drilling Company, who drilled the well, has used with marked success for several years in the Mid-Continent fields gas-gasoline engine driven rotary drilling equipment. On this well a 350-horsepower Waukesha engine provided power for the draw works and two Waukesha engines, 350-horsepower and 250-horsepower, power for the mud pumps.

In this hook-up power is transmitted to the draw works through a two-speed reduction gear and a heavy duty reversible clutch. There is an 18-piece V-belt drive, one-to-one ratio, between the engine and the reduction gear, a No. 4 Standard rotary chain between the reduction gear and reversible clutch and the draw works.

The two-speed reduction gear provides a 3.5-to-1 reduction on the low-speed side. A double jaw type clutch between the high and low gears on the final reduction or take-off shaft makes it possible to obtain the desired speed change.

The reversible clutch is a self-contained unit manufactured by the Portable Rig Company of Houston, Texas, and consists of a multiple friction type disc clutch with a high overload capacity. Operation of the clutch from reverse to neutral or ahead positions is entirely independent of the brake control. Both the clutch and brake are easily operated by the driller from the derrick floor. The clutch has a six-inch alloy steel shaft with a planetary type pinion gear reverse and is mounted on heavy steel "H" beams.

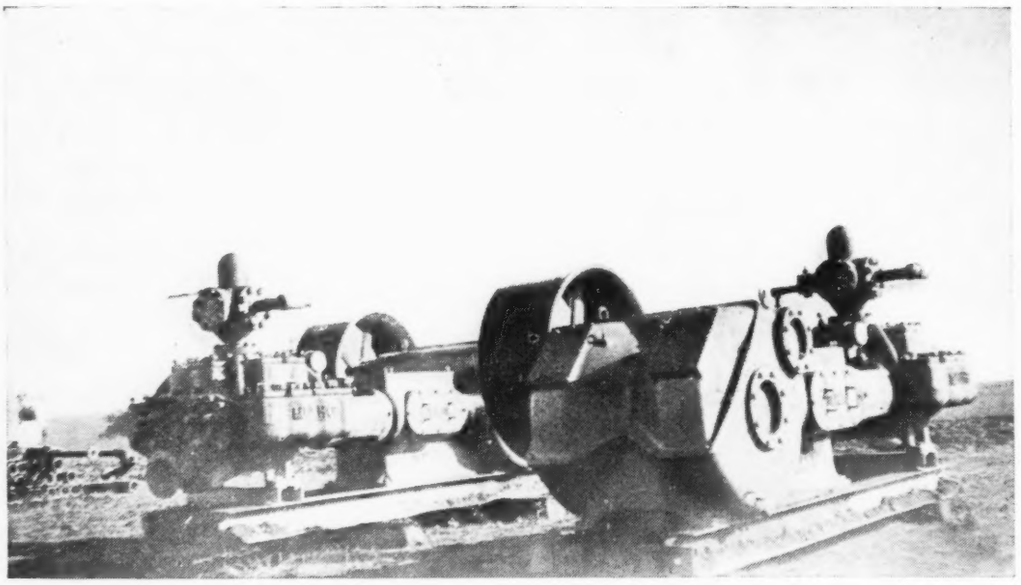
There is a 20-tooth drive sprocket on the clutch and a 19-tooth sprocket on the jack-shaft of the draw works, which is an Emsco H. R. B. type. A maximum engine speed of 1000 r.p.m. will give a maximum speed of 185 r.p.m. on the jack-shaft of the draw works and the minimum engine speed a minimum of 77 r.p.m. on the jack-shaft of the draw works.

Two 7¼-inch by 18-inch heavy Oil-Well Mud Hog power slush pumps were used. Each was driven by the engine through a Tex-rope drive having a sheave of eighteen inches diameter on the engine and a 52-inch sheave on the pump with approximately eight-foot centers.

Other important items of equipment used on the well that contributed to the successful run made were a Lee C. Moore 122-foot steel derrick, an Oil-Well steel crown block, a Union Tool traveling block, a Champion all-steel high-pressure hose, six-inch seamless alloy steel drill pipe and a Union Tool rotary table.

In drilling in with the cable tools the well was equipped with a one-inch 6300-foot steel drilling line and a 9/16-inch sand line, both American Steel & Wire Company products, an Ideco steel walking beam, a Marion Machine Works A-6 chain-driven sand reel and clutch, and an Ajax 13-inch by 14-inch steam engine.

J. W. Lechner and C. A. Miller were the rotary drillers on the well.



The two heavy 7¼ by 18 Mud Hog power slush pumps used on the well. Note the V-belt drive

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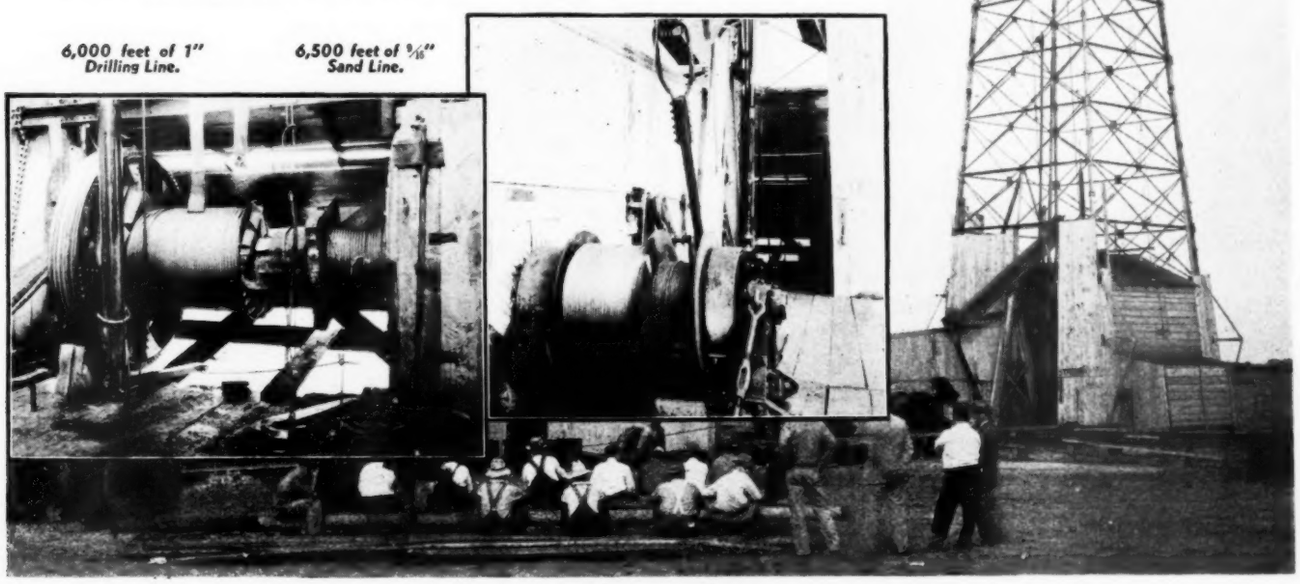
Bring in No. 1 WOLFF

Fourteen miles southwest of Perry, Oklahoma, history is being made—the development of an isolated well, No. 1 Wolff, promising a new major pool. Because of the great importance of the work—and the need for uninterrupted service—the drilling contractors, Mead Brothers, Tulsa, Oklahoma, utilized American Steel & Wire Company Drilling Lines, both Rotary and Cable Tool, and Sand Lines.

Wherever the going is tough—and the need for exceptional dependability exists—American Steel & Wire Company Wire Lines will establish remarkable records for their users. And—in less spectacular everyday work—where delays must be guarded against and economy is essential, these wire lines will be found in general use throughout the oil fields. Convenient stocks and our nearby engineers are both at your immediate call.



6,000 feet of 1" Drilling Line.

6,500 feet of 9/16" Sand Line.

A general view of the sensational new No. 1 Wolff.

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Unusual Features Employed to Build and Protect Gas Line From Corrosion

By J. H. DAMERON

California Line Built « in Rapid Time »

COMBINING unusual features of construction with an elaborate program for the protection of both buried and exposed pipe, the Southern Counties Gas Company, Los Angeles, Calif., recently completed one of the most interesting of the newer pipe line projects. The transmission artery is a 12-inch welded line from Huntington Beach to San Diego, Calif., is eighty miles long. Gas will be delivered to the intake of the new line at the Industrial Fuel Supply Company's Huntington Beach compressor plant and at the Rose Canyon terminus of the line to the Consolidated Gas and Electric Company, San Diego. The line was built with 12¾-inch O. D. plain end steel line pipe weighing 34,552 pounds per lineal foot, except where extra heavy pipe was used for water crossings. For these sections 81-pound double dipped galvanized pipe with a ⅝-inch wall was used. Where the line is exposed to atmosphere on bridges or spans crossing arroyos, 34-pound galvanized pipe was used. All pipe was shipped in 40-foot lengths.

Welding double-dip galvanized 80-pound pipe in six length sections for ocean slough crossing

Construction work was divided into two divisions. Thirty-five miles of the line extending from Huntington Beach to the Orange County line southeast of San Clemente was built by the transmission company's own crews. This section of the line was acetylene welded by the Lindeweld process.

Contract to build the remaining 45 miles to Rose Canyon was awarded to Lindgren & Swinerton, Los Angeles contractors. This section was electrically welded by the Lincoln process, and the contract for the welding was sub-let to H. C. Price, Inc., Bartlesville, Oklahoma.

To adequately protect the line from corrosion a soil survey was made under the direction of A. B. Allyne of the Southern Counties Gas Company. Shepard Earth Resistivity Meters were used by two crews experienced in this type of work.

Soil rod meter readings were taken at locations spaced 600 feet apart, one at a depth of 15 inches and another at a depth of 30 inches. The readings, along with information concerning the character of the soil, drainage and other data were recorded in field books and later transferred to a large scale map.

With the information plotted on the maps it was decided to divide the line in sections to show where coatings should be applied and where the line would be left uncoated. Coatings were applied in sections where the soil showed a low resistivity reading. Where the line traversed a section of soil showing a resistivity reading of 10,000 ohm-cms or more the pipe was laid bare. The high value was selected as a division guide for protected and unprotected sections because of the high cost of reconditioning in similar soils.

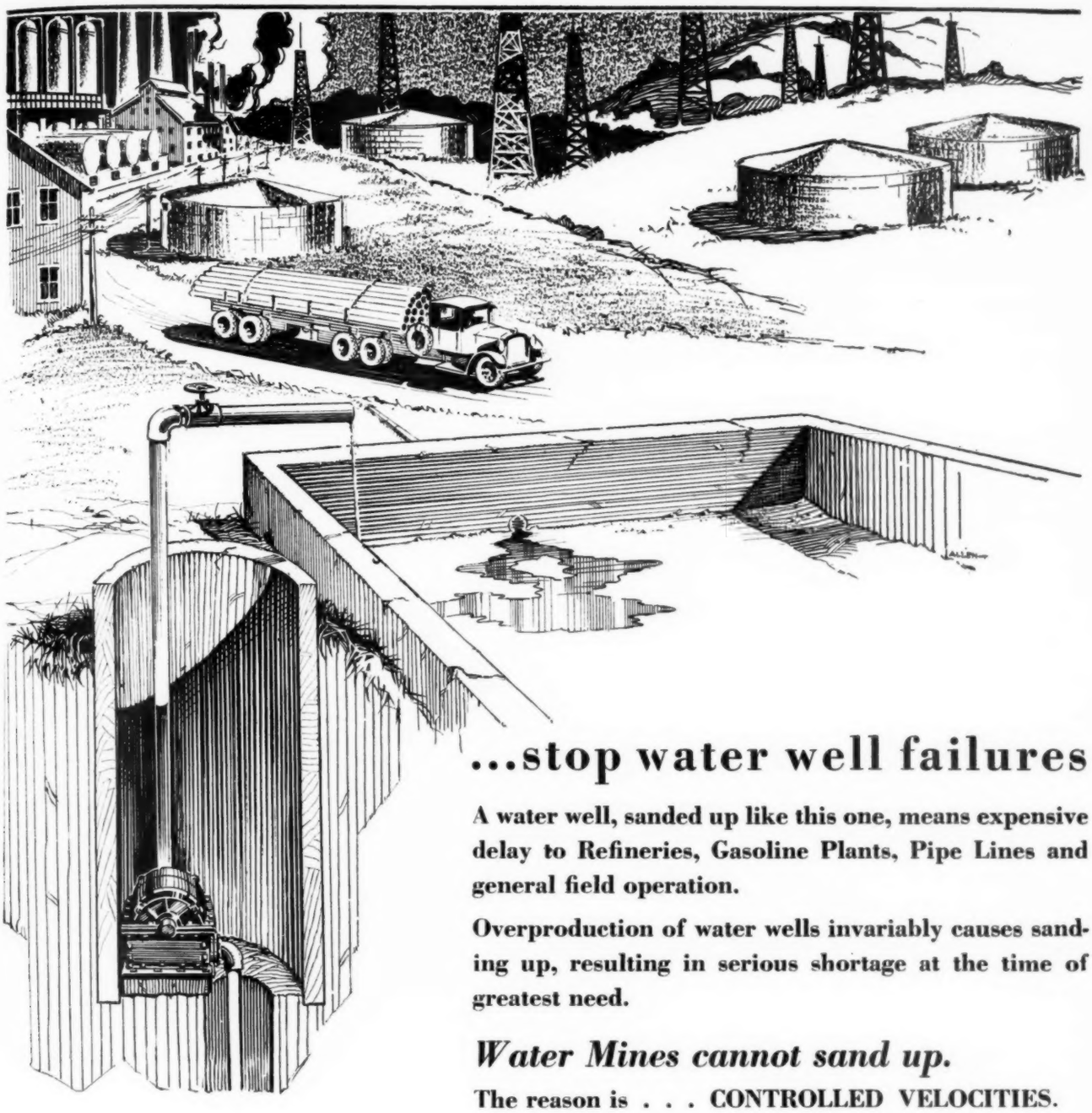
Two types of coatings were used to cover the protected sections. One was a coating applied in the field and consisted of a coal tar primer over which two coats of coal tar enamel with a melting point of 200 degrees F. were applied. After the enamel had cooled, the pipe was wrapped with an asbestos felt wrapper. The other type of coating, applied to the pipe in a warehouse yard, consisted of an asphalt primer, hot coat of blended asphalt, rag felt wrapper, another hot coat of blended asphalt followed by another rag felt wrapper, and finally an application of Kraft paper.

Perhaps the most interesting feature of the methods employed to protect the buried pipe is the provision for electrical drainage in the coated sections, to supplement the protective coatings. By means of this feature, electrical currents from the pipe are returned to the soil through electrodes and the potential of the protected sections of the line will be kept below the potential of the soil. Thus every imperfection in the coating, due to blisters and breaks, is protected from corrosion at the exposed points.

The use of this method requires the introduction of current through connections to the protected pipe and draining the current to properly designed anodes. Currents from the soil entering the pipe through imperfections in the coating will be drained away by the current introduced into the pipe. The electrical drainage design will not be completed until measurements have been taken to determine the electrical resistance of the coated sections.

In a paper delivered before the Technical Section, Pacific Coast Gas Association, F. A. Hough of the Southern Counties Company dealt at length with the methods to be employed for the protection of the line. Basing an estimate on the results of the soil survey and other data, Mr. Hough estimated the operating expense of the electrical protection will be $7.70 per year per mile of pipe so protected.

Sections in which electrical drainage will be used vary in length from 4000 to 75,000 feet. Dresser couplings, with insulated gaskets, were installed 40 feet from the end of each protected section. Locating the couplings in this manner was done to prevent the possibility of current flowing from the bare section through the soil, and into the coated section.



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A water well, sanded up like this one, means expensive delay to Refineries, Gasoline Plants, Pipe Lines and general field operation.

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which would cause rapid corrosion to the bare section near the insulated joint.

Another feature of interest in this line was the use of galvanized pipe, with welded joints coated with molten zinc, for the submerged and bridge type of stream crossings. Six submerged type crossing were made in salt water flats and channels. In addition, six streams were crossed on highway bridges and several deep gorges were crossed by spans approximately 100 feet in length. Heavy pipe was selected for the submerged crossings to prevent the line from floating and to give added pipe life in the event the galvanizing fails. Pipe for the exposed crossings is 34-pound galvanized.

The crossings were made up on shore and dragged into place. During welding operations galvanizing was burned off the ends of the pipe. In order to protect the welds and the pipe where the galvanizing was burned off, molten zinc was sprayed on the metal. It is the first time that such a method has been used in main line transmission work.

This work was done by means of a spray gun manufactured by the Metallizing Company of America, Los Angeles. Zinc is fed through the gun in the form of wire by means of air pressure. The oxy-acetylene flame in the nozzle of the gun melts the metal and air pressure breaks the molten metal into atoms and sprays it on the work at a terrific speed. Force of impact on a thoroughly roughened surface makes the sprayed material bond tightly to the metal.

For this work an air compressor delivering 110 cubic feet per minute was required. The metal spray equipment requires about 25 cubic feet per minute but the sand blasting equipment, required to prepare the weld and pipe for the application of sprayed zinc, requires more capacity. After the metal has been thoroughly roughened the sprayed zinc is applied.

Each pass over the metal with the spray gun deposits a coat of zinc approximately .0025-inch thick. About one ounce of zinc per square foot is required for each coat. Usually, two to four coats were applied. Little time was required to coat the welds.

Welding operations on the northern section were carried on by the transmission company's own crews using the Lincoln-weld process. With a relatively small crew of welders, thoroughly experienced in their work, the welding schedule was completed daily without difficulty. The line was tested in half-mile sections with 100 pounds air pressure and certain sections of the line withstood an 800-pound hydraulic test. None of the welds failed during any of the tests.

While welding operations were in progress inspectors worked along the firing line, coaching welders and cutting coupons at regular intervals. The coupons were tested in the field by means of a portable tensile strength testing machine. All welds were required to develop the full strength of the pipe.

All angles in the line were made with mitre welds except where the pipe changed direction on bridge crossings. At these points fittings for welding were used.

The southern end of the line was electric welded by means of Lincoln machines. Most of the line ran alongside a heavily traveled highway, necessitating limited working space. The pipe was lined up on dollies, a streamline back-up ring inserted and then welded. The ring used is slightly thinner than the usual back-up ring used on welded lines.

The average speed of electric welding was 41 welds per man per day and the maximum 64 welds. Out of a total of 7128 electric welds only nine pin-hole leaks were found.

The only difficulty encountered in moving equipment was when slough crossings were encountered. Machines were either located on the bank or on a bridge and cables up to 2000 feet in length extended to the job. In these instances $\frac{5}{8}$-inch wall pipe was being welded but no difficulty was experienced in getting sufficient current.

The heavy pipe for the submerged type slough crossings was made up on shore or on short trestles and then dragged into place by means of winch equipped tractors. At each of these crossings a wrinkle type expansion joint was installed where the weight of pipe was changed.

A work train was chartered to assist in the construction of the San Elije slough crossing which is 4200 feet long. A crane mounted on a truck was anchored to a flat car and by means of the crane the pipe was lowered to the side of the railroad fill. A tractor was used to move the pipe to location and a 10-inch sand pump mounted on pontoons made the excavation into which the line was lowered.

Whenever the line crossed an arroyo with a span 90 feet or more in length, hog rod trusses anchored to the line on both sides of the span were used to make the span rigid. The span was welded on the bank of the arroyo and the truss rods were welded to the section. Truck cranes were then used to lift the span into place.

Spur gear operated Venturi type plug valves with a six-inch blow down valve were installed approximately every five miles.

The present capacity of the line is 24,000,000 cubit feet of gas daily and this capacity may be increased to 30,000,000 cubic feet daily by the addition of a booster station. The line represents an investment of approximately $1,000,000 and, from the standpoint of corrosion, is believed to be one of the best protected of any line running through terrain with enormous long sections of highly destructive soil.

Shramm 240-Cubic Foot Compressor being used to test the welded line.

The New Oil Tanker "R. L. Hague"

IT will probably not be long before the Standard Oil Company, through its various subsidiaries, has a motor tanker fleet of 1,000,000 tons dead-weight capacity. It has now a bigger tonnage than any other shipping concern, although the ships sail under several different flags and under different nominal ownership.

In July of 1930, the Standard Shipping Company, which operates most of the Standard Oil Company's fleet, ordered, in Europe, nine similar tankers which are among the largest vessels of their class. The first of these nine 12½-knot oil-carrying vessels to be delivered was the "R. L. Hague," named after the Vice-President and General Manager of the Standard Shipping Company.

This ship is of the latest design in bulk oil-carrying motorships, embodying many features of construction and equipment that tend to make the vessel one of the finest tankers afloat. It has a length between perpendiculars of 520 feet, a moulded beam of 70 feet, a moulded depth of 38 feet 9 inches, a cubic cargo capacity of approximately 140,000 barrels, and a dead-weight capacity of about 17,800 tons on a mean loaded draft of 30 feet 5½ inches.

Within the cargo oil tank space the vessel is single deck, has two longitudinal bulkheads and is subdivided by transverse bulkheads into nine main tanks, each having three compartments. The cargo oil pump room, located amidships, contains two horizontal main pumps and a vertical stripper pump, all of which are steam-actuated.

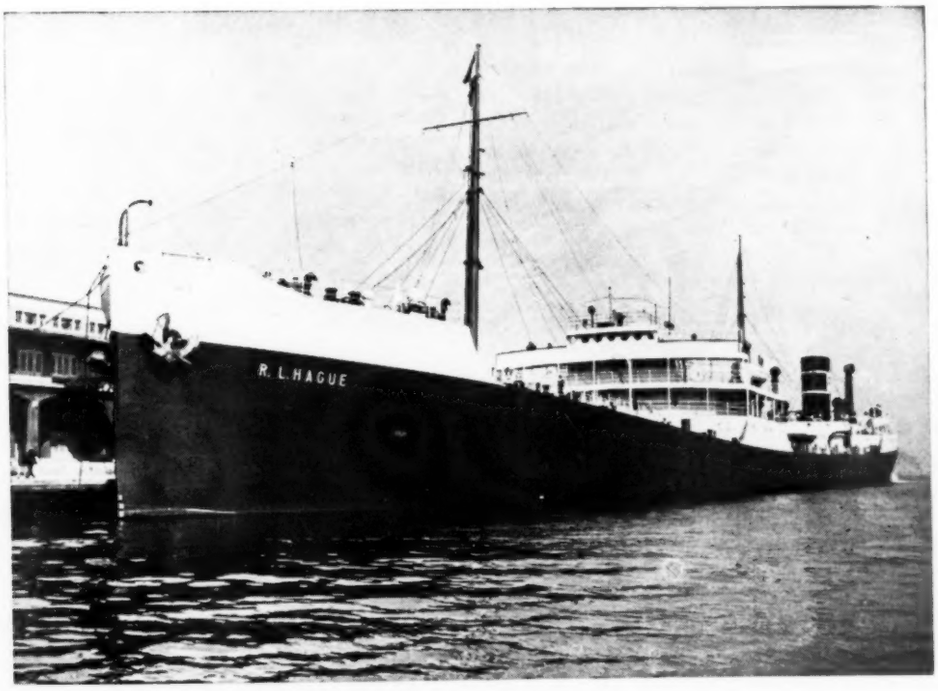
The propulsive power plant, located aft, consists of two single-acting, two-cycle, six-cylinder, solid injection, direct reversible marine Diesel motors. Each motor is capable of developing 2,250 S. H. P. at 120 R. P. M., the combined power of both motors being sufficient to propel the vessel at a sea service of at least twelve knots per hour.

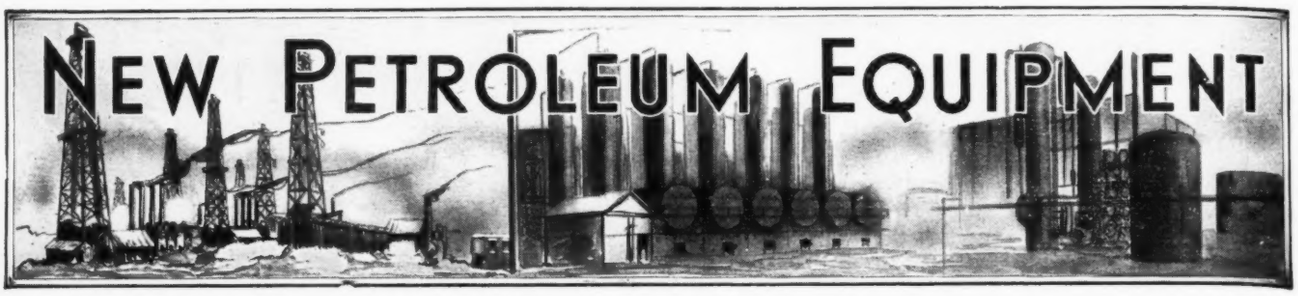
The principal auxiliary pumps required for normal operation of the vessel are combined into two pump groups, actuated from the propelling power shafting through mechanical clutching and silent chain drive. Each pump group consists of five vertical simplex pumps, four of which are for main motor water circulating purposes, the remaining pump for bilge purposes and the additional small pump for exhaust gas boiler feed water service. These pumps operate at 68 r.p.m. when the propulsive power plants are running at 120 r.p.m.

All other auxiliaries of the vessel, including the steering gear, windlass, winches, generators and air compressors, are to be steam operated, the steam, when at sea, being generated in two vertical thimble-tube type exhaust gas boilers, and augmented by steam generated in two Scotch boilers. The exhaust gas boilers, for operation when exhaust gases from the propulsive power plant are available, are each provided with a spark arrestor combined with a steam drier and a feed water preheater. The exhaust gas and Scotch boilers are so interconnected that when the steam in the exhaust gas boilers is reduced, the Scotch boilers automatically augment the steam supply through actuation of their automatic burners.

The vessel is equipped with special main motor circulating water systems so that the normal sea water supply of cooling water, may, for river and sediment-entrained water locations, be shifted to a cooled and recooled water system lying entirely within the vessel.

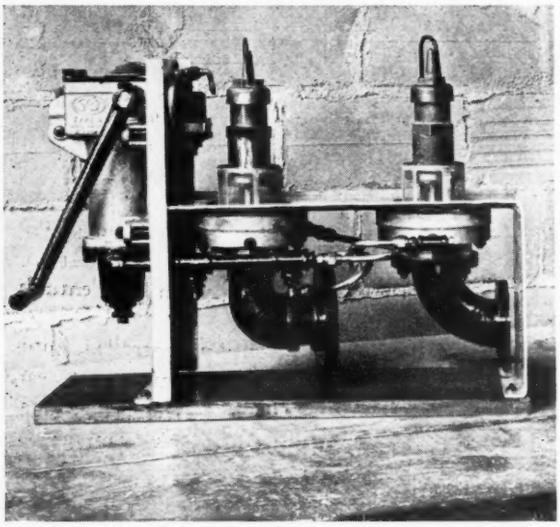
The vessel is equipped with electrically controlled, automatic and hand-steering, actuation of the steam steering gear, a CO_2 fire protective and extinguishing system for the machinery spaces, and Butterworth System of tank cleaning.





Hydraulic Internal Valve System

Two methods of flange connections are illustrated by the accompanying photograph showing the new S & J hydraulic internal valve system, a development of Shand & Jurs, Berkeley, California. The valve shown on the right has a radius tube bend with flanges welded thereon. This is bolted onto studs which are provided in the base of the hydraulic valve. The latter also has a flanged base which bolts onto the studs in a welding pad on the tank.



The valve illustrated above is similar except that it shows the application of standard screwed fittings instead of bolted tube bends. This illustration shows the complete unit of two valves, ignition control and operator; also method of connecting same with the hydraulic lines. Attention is called to the pigtails in the hydraulic line, which are so arranged that the valve cannot possibly trap in them. Bleeding of air in these valves is accomplished by unscrewing a screw on the flange of the valve.

Oilproof Okocord

In certain types of service portable cords are subjected to the continual attack of oil resulting in deterioration not only of the outer coverings, but eventually of the insulation. To meet this condition The Okonite Company of Passaic, New Jersey, has developed a full line of portable cords and cables having a special outer sheath which is impervious to the destructive action of oil or grease. This line of cords and cables is called "Oilproof Okocord."

As the name implies, Oilproof Okocord possesses all the good qualities of the Okocord line plus continued resistance to oil, thus rendering it highly suitable for use around machine shops, garages, refineries, oil wells, etc. Strong sunlight and Ozone also have little effect on this cord.

Larger Series of Nitralloy Steel Pumps

The Northern Pump Company, Minneapolis, Minn., has announced a new and larger series of Nitralloy steel pumps, to be known as the "XE" series.

Using the same laminated plate construction worked out in its two smaller series, XA and XD, the company now has Nitralloy pumps to offer in capacities from one-fourth G. P. M. to 42 G. P. M. at 1200 r.p.m. The new series XE capacity range is from 14 G. P. M. to 42 G. P. M. at 1200 r.p.m.

The extreme hardness of Nitralloy steel (1000 Brinell) makes these pumps ideal for all types of oil services, including the handling of dirty crude oils and distillates at high pressures. For non-lubricating oils, the XE pumps would be equipped with Nitralloy plate bearings. Roller bearing pumps handling clean lubricating oil would be good for pressures up to 1600 pounds on continuous service.

Because of the high efficiency and wear-resisting qualities, these pumps with roller bearings are suited for installations on hydraulic hoists, dump trucks, stokers, machine tools, road machinery and other hydraulically-operated mechanisms.

Dearborn Concentration Hydrometer

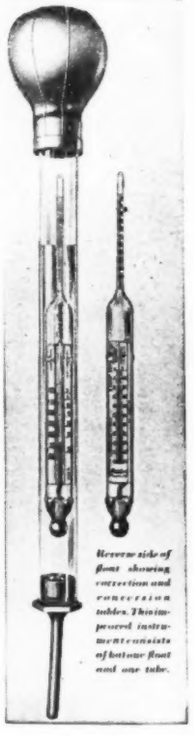
The Dearborn Chemical Company, Chicago, Ill., has introduced an improved concentration hydrometer for determining total dissolved solids in boiler waters that has several distinctive points. It consists of but one float and one tube, all scales being enclosed in the float, a unique feature.

This novel method of construction has many advantages. The instrument is very compact, requires no special care in operation and will stand rough handling because of the single tube design. The danger of float stem breakage is eliminated. The operation is simple and readings can be taken very easily from a distance.

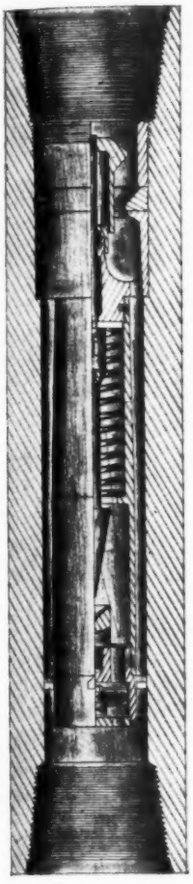
The instrument may be easily taken apart for cleaning. It is never necessary to remove the rubber bulb, the float is withdrawn from the jar or tube by removing the lower rubber fitting. The outer rim of this fitting is hexagonal in shape, which prevents the instrument from rolling when at rest.

The hydrometer is quick acting because of a mercury thermometer and the space between the tube and float permits the float to rise more rapidly. The float is provided with substantial projecting knobs to prevent friction of float against the tube.

The float can be removed from the assembled instrument and operated in a separate container if desired.



Shaffer-Boles Formation Tester



A RECENT addition to the line of tools manufactured at the Santa Fe Springs, Calif., plant of the Shaffer Tool Works is the Shaffer-Boles Formation Tester. This device tests potential production of oil sands and tests for water.

The tool consists of a valve which may be opened or closed, as desired. Below the valve, attached by a left hand thread, is a packer adapted to the conditions in the hole. The Tester is run in the hole on drill pipe or tubing and the packer is set either in the casing or on the shoulder of the rat hole formed by the core drill. The Tester may be run in the hole closed. After it is set the valve is opened by a few turns to the left and a sample taken. After the hole is tested the valve may be closed and the whole tool withdrawn with the sample. If for any reason the packer should stick, a few turns to the right will disconnect it. The sample is then withdrawn from the hole, after which the packer is washed over and recovered.

This tool has been thoroughly tested and the results have saved operators a great deal of expense and time as they were able to learn the exact condition of the formation. This device is now available on a rental basis.

Thiokol Packings

THE GARLOCK PACKING COMPANY of Palmyra, N. Y., has announced the development of a number of packing items such as diaphragms, discs, gaskets, etc., made of various Thiokol compounds.

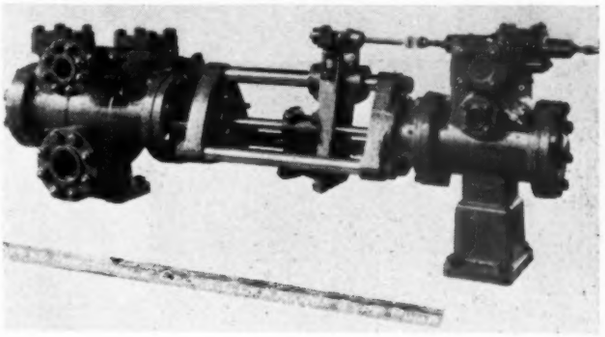
This material, a new chemical product, according to the manufacturers has most of the characteristics of rubber but is not affected by solvents, and does not oxidize. No sign of deterioration has been found in the new packing items even when in use for long periods of time.

Because of their unusual practicability in the petroleum industry, Thiokol packings are being featured in the Garlock line. Discs made from this material have been found particularly successful in the automatic valves used in gasoline dispensing stations on filler hose, tank wagon valves, and in ordinary pipe line valves handling gasoline, benzol and other rubber solvents.

Close Clearance Type Pump

NATIONAL TRANSIT PUMP & MACHINE COMPANY, Oil City, Pa., is building a close clearance type of pump for handling high test gasoline, butane, propane and other highly volatile liquids with high efficiency.

The suction valves of this pump are located on the side of the pump below the discharge valves. The suction opening is below the discharge ports. In operation, a considerable volume of liquid is continually against the suction valves through



which it enters easily and with little agitation when these valves open. The larger sizes of single pumps are fitted with four suction valves, two on each side of the fluid cylinder.

Extra deep stuffing boxes prolong the life of packing and rods, because only very light pressure is required on the packing. Tie-bar construction cuts down the weight, and renders the stuffing boxes easier of access, thus inviting more frequent inspections and adjustments. The same construction also lessens the amount of heat transferred between the steam and fluid ends.

Both single suction and double suction pumps are equipped with transit improved steam valve gear.

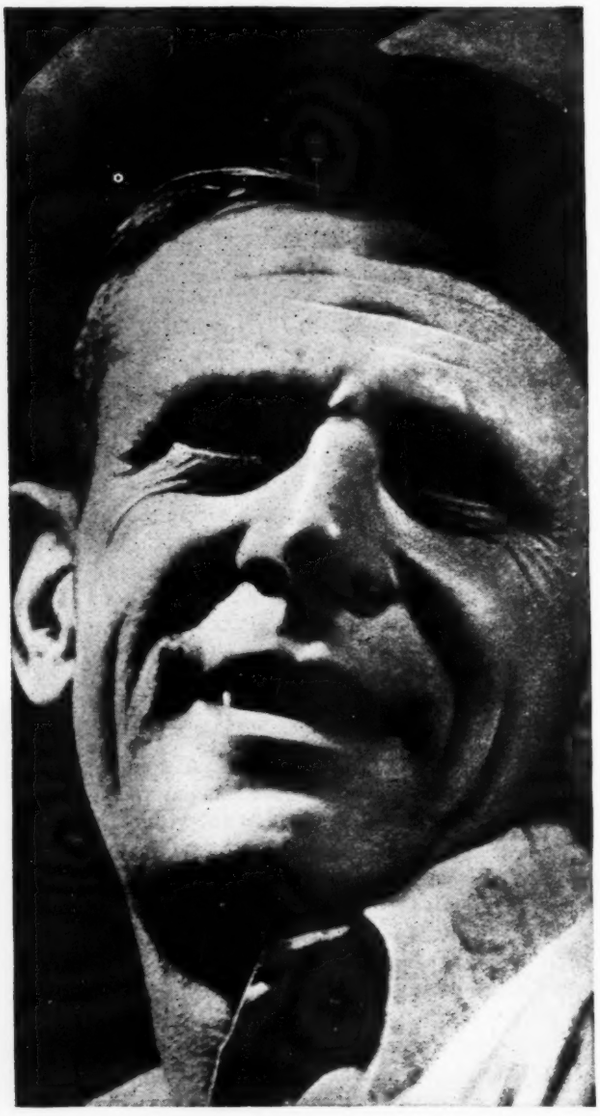
Worthington HiVoL Pumps

THE Worthington Pump and Machinery Corporation, Harrison, New Jersey, has introduced an improved line of direct acting steam pumps, known as the "HiVoL," which by actual test show clearances of between 12 and 17 per cent (depending on the size and stroke). These truly close clearances have been attained by applying the principles of gas compressor design to the construction of high volatile liquid pumps.

In the HiVoL pump the suction and discharge valves are located at the extreme end of the liquid cylinder—the suction valves below, and the discharge valve above the piston on the vertical center line of the cylinder. This design accomplishes three things: a straight-line flow of liquid through the cylinder; maximum suction valve area; and minimum volumetric clearance. As a result, there is little agitation of the liquid in the cylinder and but little release of gas.

To remove any gas which may accumulate in the cylinder as the result of failure of the liquid supply, the pumps are fitted with a hand bypass valve. One port of this valve is just above the discharge valve while the other leads directly to the cylinder beneath the discharge valve. By opening the bypass, liquid in a solid stream can be admitted from the discharge to the suction side of the pump. In this way, a full flow condition is established and all the gas is expelled from the liquid cylinder and the pump is again quickly brought to its full volumetric efficiency.

"Nix on the Baloney ...what we want is LOWER COSTS" says Sucker Rod Bill



COST sheets mean a lot more than theories, THESE DAYS. Experiments with this or that kind of "special" rod run into money—and grief. Maybe that is why so many operators are turning to Reading Puddled Iron Sucker Rods—the rods that cost LESS to use.

It is a FACT—proved by actual service in the toughest wells—that *Reading Rods reduce rod costs 84% to 89.3% per day.* And those percentages figure in labor, maintenance AND the original cost of the rods themselves!

Reading Puddled Iron Sucker Rods cost less because they LAST LONGER in service. Find this out for yourself by comparing them with the finest special rods under similar conditions. Put Reading Rods in your own wells and check off how much MORE they save you. We're willing to stand or fall by your findings!

READING IRON COMPANY
Philadelphia
57 Years of Serving The Oil Industry

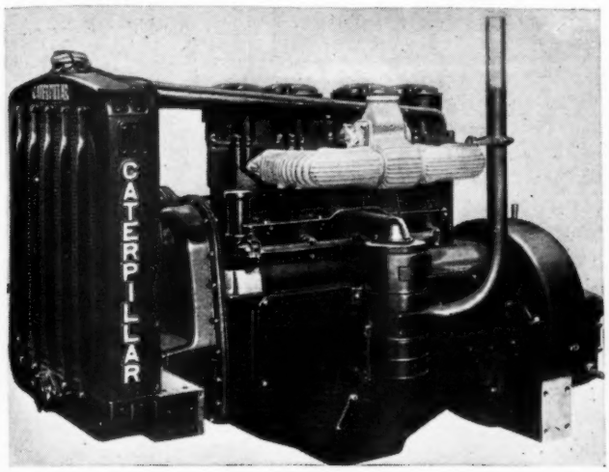
READING
PUDDLED IRON SUCKER RODS

Science and Invention Have Never Found a Satisfactory Substitute for Genuine Puddled Iron

Caterpillar Stationary Unit

THE CATERPILLAR TRACTOR COMPANY, Peoria, Ill., is now offering to the trade a line of its proven tractor motors that have been adapted for stationary and industrial power units.

Heading this list of Caterpillar engines is the Caterpillar Diesel, a 6⅛x9¼-inch, four-cylinder engine, turning at 700



r.p.m. Its unusual simplicity in design and construction makes for economical operation. There are records of these engines working for months on the Mississippi levees that have only averaged two and six-tenths gallons of fuel oil per hour.

The next engine is the Caterpillar Sixty-Fve. This is a four-cylinder 7x8½-inch motor, turning at 650 r.p.m. This power unit has been through many years of gruelling, tough performance in the heavy duty field, and is now offered as a reliable stationary unit.

The Caterpillar Fifty, Thirty-Five and Twenty-Five engines very closely resemble each other in design, construction and relative performance. The size and speeds of these engines are as follows:

Engine	*No. of Cylinders*	*Bore*	*Stroke*	*R.P.M.*
Fifty	4	5½	6½	950
Thirty-Five	4	4⅞	6½	950
Twenty-Five	4	4	5½	1250

Lead-Coated Steel Drums for Acid-Handling

A NEW type of lead-coated steel drum of ten gallons capacity, suitable for handling, shipping and storing acids, has been designed by the Gross Engineering Corporation, 3955 West 25th Street, Cleveland, Ohio. Larger sizes may be supplied if desired.

The outer shell is made of heavy sheet steel, welded at all seams. The interior of the drum is entirely covered by a protecting coating of lead by means of the Gross "Leadhesion" process. In this process, the steel surfaces to be protected are first treated with a special liquid and are then immersed in a tank of pure molten lead. This produces a thin perfectly adhering lead film which is thoroughly amalgamated with the steel itself, the requisite additional thickness being built up on this film.

An interesting feature is the renewable outlet or outlets from which the acid is poured. Outlets are made in two parts, a thick coating of lead being put on the inner sides normally exposed to the acid. Should the outside of the outlet lip become corroded by acid drippings, however, it is an easy matter to remove the upper section of the outlet and to substitute another. The protective coating can then be readily replaced by any leadburner of average skill.

Hills-McCanna Ball Bearing Centrifugal Pumps

HILLS-MCCANNA Ball Bearing Centrifugal Pumps are designed and built to provide a means for greater capacity for each horsepower used, to reduce maintenance cost to a minimum and to render long service.

Shaft and impeller alignment is accomplished by providing ball bearings to carry the load in any direction. Not only does this construction lengthen the life of the pump, but it reduces friction losses to a minimum, and permits unusual close tolerance in fitting the impeller in the housing, which increases the delivery for each horsepower used.

The stuffing box is of the split screw gland type. There is no bearing in back of the packing, eliminating the possibility of lubricant entering the pump and mixing with the liquid handled.

All parts coming in contact with the liquid can be made of any machineable ferrous or non-ferrous alloy. Pumps are carried in stock made of acid-resisting bronze, Monel metal, pure nickel, Hills-McCanna No. 45, No. 55 and 50A alloys and of close-grained cast iron.

The pump has removable inboard and outboard heads, which is a feature when handling fluids that are highly corrosive, as it is only necessary to replace the heads and impeller.

Literature is available by writing to Hills-McCanna Company, 2349-59 Nelson Street, Chicago, Ill.

Oxy-Acetylene Welding and Cutting Equipment Truck

THE LINDE AIR PRODUCTS COMPANY, 30 East Forty-Second Street, New York City, has introduced a new cylinder truck, known as No. 5, for distribution east of the Rocky Mountains. It greatly increases the ease and convenience of moving welding or cutting equipment from place to place in the shop or yard and of transporting the outfit to outside jobs.

The frame of the No. 5 cylinder truck is made of 1¼-in. angle iron welded into a permanently rigid unit. A beveled steel plate welded to the frame forms the cylinder platform. The handles are made of 1¼-inch pipe curved to provide a firm, easy grip. The handles are bolted to the cylinder platform and to the upper part of the frame.

Cylinders are held firmly in position on the truck by means of chains which are adjustable to accommodate different sizes of cylinders.

The truck has 12-inch cast iron wheels with two-inch tires. Its overall size is 48 inches in height and 30 inches in width, with a weight of only 80 pounds.

A feature of the truck is its easy dismantling design, which makes it easy to ship from location to location.

New Griscom-Russell Heat Exchanger

AN INGENIOUS design of heat exchanger has been developed by Griscom-Russell Company, 285 Madison Ave., New York City, to meet the problems found in heat transfer processes of petroleum refineries and chemical plants.

It consists of four straight tubes bonded together by means of a number of closely spaced thin metallic plates. The tubes are expanded into holes in these plates so as to assure a permanent contact between tubes and plates. A return member connects each pair of tubes at one end, this end being free to move as the unit expands or contracts on change of temperature. The other end of the unit consists of a stationary head into which the tubes are expanded and which contains the inlet and outlet connections.

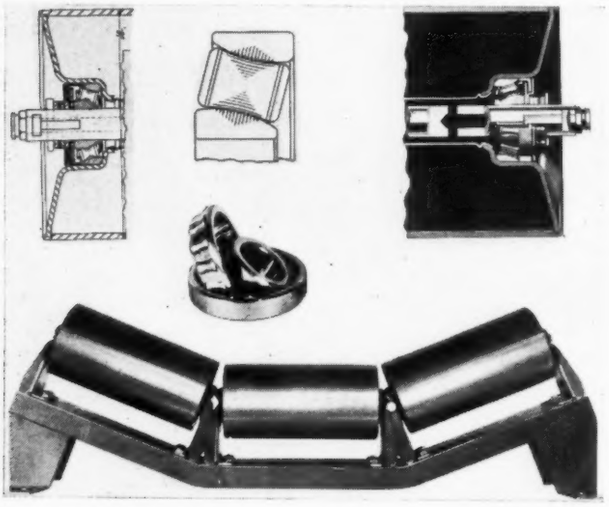
The hot vapor or liquid passes and returns through two of the tubes and the colder liquid passes and returns through the other two, heat being transferred by conduction through the many plates connecting the tubes. The units are standard and interchangeable and may be set up in stacks with parallel or series connection for any desired duty. Various designs are made for pressures and temperatures and suitable materials may be used to withstand corrosive action.

Accumulation of sediment is prevented in this design by the high velocity and straight-through flow of the fluids passing through the tubes.

Anti-Friction Conveyor Carrier

A NEW Anti-Friction Conveyor Carrier of improved design has just been announced by the Barber-Greene Company, Aurora, Ill. The roller bearings are of an exclusive design and principle, being self-aligning, and taking thrust as well as radial load.

Each size of carrier has but one size roller unit, making these units and component parts interchangeable. The Barber-Greene carrier is made to interchange with any standard carriers for making replacements. The roller is made of 5½-inch diameter seamless tubing, No 9 gauge thick metal. The ends are made of pressed steel with the outer roller race inserted under pressure. The inner tube is 1⅛-inch in diameter with two shoulders, one at each of the ends.

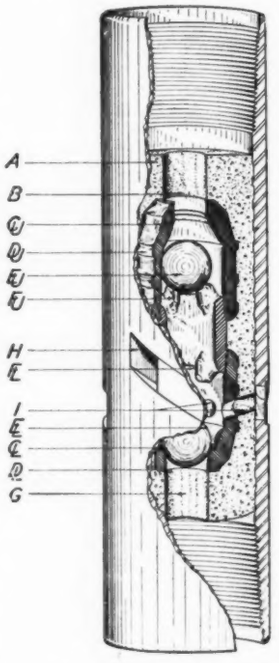


The spindle is ¾-inch diameter, made of selected cold rolled steel, drilled and tapped on each end for grease and Alemite, slotted to fit in the end brackets, and provided with two flats to lock the grease-seal washers. The spindle is also drilled and reamed at each end for taper pins. The bearings are held in by the two labyrinth seal washers, shimmed so as to keep bearings tight. There are three collar spacers between the bearing race and taper pins. In case of wear on the bearings or if for any reason the bearings should be tightened up, it is a very simple matter to take out the taper pin on one side, insert necessary shims, and drive in the taper pin again.

Baker Whirler Cementing Collar

THE BAKER OIL TOOLS, INC., Huntington Park, Calif., has perfected a product, known as its Whirler Cementing Collar, to meet the demands for an effective and dependable means of cementing a combination job or of cementing off at any point where the collar is placed in the pipe string. The collar is extremely compact, being but 28 inches in length. It also acts as a float collar when running the string into the hole and yet contains no metallic parts to cause trouble when drilling out.

When running a string into the hole the upper ball (EU) seats against the upper valve seat (CU) and the whirler cementing collar functions as a float collar. During this time the heavy lower ball is raised off its seat by the pressure of the fluid and rests against the lower reversed ball stop (FL). This allows a free upward movement of the fluid through the lower inlet passage (G) and thence out through the side-hole passages (I) and the whirler ports (H), keeping the passages and ports clean and unobstructed for the cementing operation which follows.



With the string in position and the collar at the desired point in the hole, cementing operations are started. The upper valve (D) then opens and the ball (EU) rests on the upper valve stop (FU) to give free passage to the cement. The lower, heavy ball (EL) now rests on its stop (CL) and thus prevents passage of the cement into the pipe below and forces it to flow out through the side-hole passages.

The cement, passing out the side-hole passages, contacts baffle plates which are set in the wall of the collar. By means of these baffles, that form the whirler ports, the cement is deflected in both an upward direction and around the pipe. This gives it a whirling or spiral motion as it leaves the collar and insures an even distribution around the pipe. This also eliminates the danger of channeling and retards the velocity of the cement so that the cement has every opportunity to settle uniformly between the pipe and the wall of the hole.

When the cementing job has been completed and the plug (A) has bumped, the light upper ball (EU) floats up and seats against the valve seat (CU). This prevents any movement back up the pipe that may be caused by back pressure.

Under certain conditions it is probably advisable to use the cementing basket in connection with the whirler cementing collar. Where there are cavings or settlings in the hole this will form a bridge and in any case the basket gives an additional precaution which may be desired.

For additional security—

Specify

National seamless external *upset* tubing

ESPECIALLY FOR DEEP WELLS, CROOKED HOLES AND OTHER ADVERSE CONDITIONS

THE seamless walls of NATIONAL A. P. I. External Upset Tubing, together with its heavy upset ends give extra strength and security where most needed—all its visible features plainly denote correct balance of metal against stress, for every demand of service. There are no welds to open under strain and concentration of wear or from the cutting action of sucker rods. The thickened ends afford abundant wearing metal, force any bending away from the joints, and give increased resistance to the crushing action of the coupling—an important safeguard where tubing is to be made up and broken down again and again.

Especially in the deeper wells, in crooked holes and wherever drilling conditions are most severe, this dependable tubing is a standby of operating men. In working with it, they find an extra measure of security against grief and loss. Their experience, in every field, East or West, has made it—

America's Preferred Tubing

NATIONAL TUBE COMPANY

Frick Building, Pittsburgh, Pa.

QUALITY PRODUCTS — Dependable Service

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

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UNIVERSAL ATLAS CEMENT COMPANY

Pacific Coast Distributors—Columbia Steel Company, Russ Building, San Francisco, Calif. *Export Distributors*—United States Steel Products Company, 30 Church Street, New York, N. Y.

Testing of Cut Oil[1]

By WM. WOELFLIN☆

ONE of the most important tests made on crude oil is the test for the amount of water, emulsion and solid impurities or "B. S. & W." in the oil. The two methods in general use for making these tests are the centrifuge method, and the distillation method. Only the centrifuge method, which is the one used most in the field, will be taken up in this article.

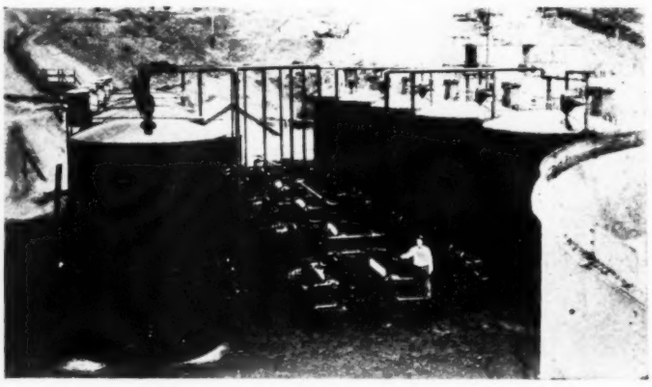
The centrifuge method as used in the oil industry is based on the A. S. T. M. Standard Method of Test for Water and Sediment in Petroleum Products, by means of Centrifuge (No. D-96). However, a number of changes have been made in the A. S. T. M. method, particularly in the diluent (cutting solution) used, the speed of the centrifuge and the size of the centrifuge tubes. The first two changes were made in order to centrifuge down all finely divided emulsion in the oil. The third change was made in order to use portable centrifuges which in most cases are hand driven. Since the actual procedure of making centrifuge cuts is so well known, this procedure will not be repeated, but the reader is referred to the A. S. T. M. method No. D-96. The changes from the A. S. T. M. method will, however, be discussed further.

Wm. Woelflin

The function of the cutting solution is to give a light gravity mixture, so that the finely divided emulsion will centrifuge out, and to dissolve the asphalts and waxes, which may otherwise be precipitated to the bottom of the centrifuge tube with the emulsion. This precipitation of waxes may also occur if the cutting solution does not contain the proper solvents. When wax is precipitated, its appearance is quite similar to that of a light yellow emulsion and may give what appears to be a high cut in the oil.

In order to redissolve this wax, the cut should again be thoroughly mixed (using a pointed wooden stick to stir up the emulsion in the bottom of the tube if necessary), heated in a water bath of 110° to 130° F. for 10 minutes, and recentrifuged. If the total quantity of emulsion in the tube has been reduced, then the high cut previously obtained (without heating) was due to wax and all cuts on these wax-containing oils should be heated before centrifuging, unless a cutting solution can be found that will dissolve the wax and also allow the fine emulsion to be centrifuged down. Wax may be encountered when centrifuging oils from some of the Southern California fields, as well as in oils from the Mid-Continent and Texas.

The petroleum ether-benzol cutting solution as used in the Petroleum Rectifying Company's laboratory, is of sufficiently light gravity that the extremely small emulsion particles can be centrifuged out, and the solvent power is such that it will dissolve the waxes and asphalts present in the oil. This solution will, therefore, show the actual emulsion content of the oil.



A modern battery of ten-unit dehydrating plant in California

When using benzol as a cutting fluid, and in some cases with gasoline and ether (sulphuric), 50 ml. of the cutting fluid, and 50 ml. of the oil to be tested, is poured into the 100 ml. tubes. However, in most cases, when using the 100 ml. tubes, 75 ml. of cutting fluid is used to 25 ml. of the oil to be tested.

When using 15 ml. centrifuge tubes, the proportion of cutting fluid to oil varies from no cutting fluid and 15 ml. of oil when testing light gravity oils, to 10 ml. of cutting fluid and 5 ml. of oil when testing heavier gravity oil.

In order to show the actual amount of water in the oil instead of its emulsion content, a demulsifying chemical is added to the cut, before centrifuging, to break the emulsion. In most of the Mid-Continent fields about one drop of the treating chemical, used in the commercial dehydration of the oil in the district is added to each 15 ml. tube. In West Texas C-23 Tret-o-lite is used in running the cuts. In the Ventura, California, field the phenol used in the cutting solution breaks the emulsion.

In the Petroleum Rectifying Company's laboratory, about four to ten drops of Tret-o-lite V-25 is added to the 100 ml. tubes, when the total amount of the water present in the oil is desired. This chemical Tret-o-lite V-25 can be used to determine the water content in all California oils.

The type of machine used for centrifuging the 100 ml. tubes, in most cases conforms to the A. S. T. M. standard. However, since emulsions of very small particles size have been encountered, a centrifuge capable of whirling 100 ml. tubes at a speed of 2000 r.p.m. has been introduced in some of the Southern California fields.

When using 15 ml. centrifuge tubes either electric or hand driven machines are used. In the Mid-Continent, Texas, and Rocky Mountain fields, a hand driven machine making 1000 r.p.m. when the handle is turned at 50 r.p.m. is in general use, especially by field gaugers, because these hand machines are easily portable and do not require electric power.

The 100 ml. pointed tubes conforming to the A. S. T. M. standards are used in California fields and in most laboratories. The A. S. T. M. "pear-shaped" tubes are used in parts of the Gulf Coast, Mid-Continent fields and San Joaquin Valley fields. However, the 15 ml. pointed tubes are in general use in all parts of the Mid-Continent, Texas and Rocky Mountain fields.

While the determination of water, emulsion, and sediment by centrifuge is one of the most important tests made on crude oil, the actual method used varies within rather wide limits. The test, however, will give accurate results in the particular producing field for which it has been developed, and is in daily use as a basis for buying and selling oil.

A list of various cutting solutions with their specific gravities, and the district in which they are used, follows:

[1]Printed through courtesy of The Electric Dehydrator.

☆Research Engineer, Petroleum Rectifying Co. of California.

Components	Specific Gravity of Mixtures Ratio at 60° F.		Where Used
Benzol (90%) - - - - -	....	.875	A. S. T. M. Standard
Benzol containing 200 grams of phenol per gallon - -	....	.875	California
Gasoline - - - - - - -	....	.740	Mid-Continent, Rocky Mt. Gulf Coast, Texas Northern California West Texas, Mid-Continent
Gasoline containing 1 drop of Tret-o-lite - - - - -	....	.740	Gulf Coast Southern California
Gasoline—Carbon Bisulphide	3:1	.872	Mid-Continent
Petroleum Ether — Carbon Bisulphide - - - - -	3:1	.813	Southern California
Casinghead Gasoline — Carbon Bisulphide - - - -	3:1	.....	Southern California
Casinghead Gasoline — Carbon Bisulphide containing 200 grams Phenol per gallon of mixtures - - -	3:1	.....	Ventura Ave. Field, Calif. Petroleum Rectifying
Petroleum Ether—Benzol -	3:1	.720	Company Laboratory
Ether (Sulphuric) - - -	....	.719	Gulf Coast
Gasoline—Ether (Sulphuric)	3:1	.748	Gulf Coast

Centrifugate cuts, and gravities are the most important tests made in the field, on petroleum oils, since most oils are bought and sold on this basis. The determination of the gravity of the oil component of the cut oil will be discussed in another article which will be presented later.

How to Find the Exact Length of Any Endless Belt in the Oil Field

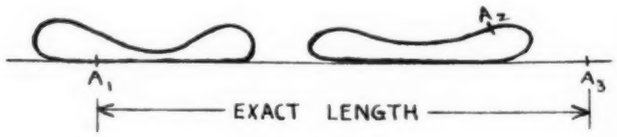
By W. F. SCHAPHORST, M.E.

Measuring around pulleys or sheaves with a steel tape, as usually directed, does not give the true belt length because the thickness of the belt is not included in such measurement.

And, likewise, measuring around the outside of the old belt with a steel tape is incorrect because it includes the entire thickness.

Measure around the pulleys, then around the belt, add the two, divide the sum by two, and you will have the correct length—for most belts of rectangular section. The correct length, always, is the length of the belt along its neutral axis.

The sketch herewith shows an infallible method for measuring the exact length of any endless belt. It is a good kink because it is so easy to perform, because it does not require a steel tape (any good straight edge, rule, or steel square will do), and it gives results that are obviously accurate.



Lay the belt on the floor as shown in the sketch, and make a mark on the belt, and a corresponding mark on the floor, as at A_1.

Then "roll" the belt toward the right, as though it were a caterpillar tractor, without permitting any slip between the belt and the floor.

Presently the mark on the belt will be at A_2.

As soon as the belt makes a complete cycle the mark on the belt will touch the floor at A_3.

Make a mark on the floor at A3. The exact length of the belt is the distance between A_1 and A_3, which is easily measured without possibility of error.

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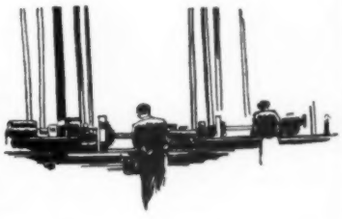

are equipped with ground plungers.

These plungers are giving better service, longer life and increased production.

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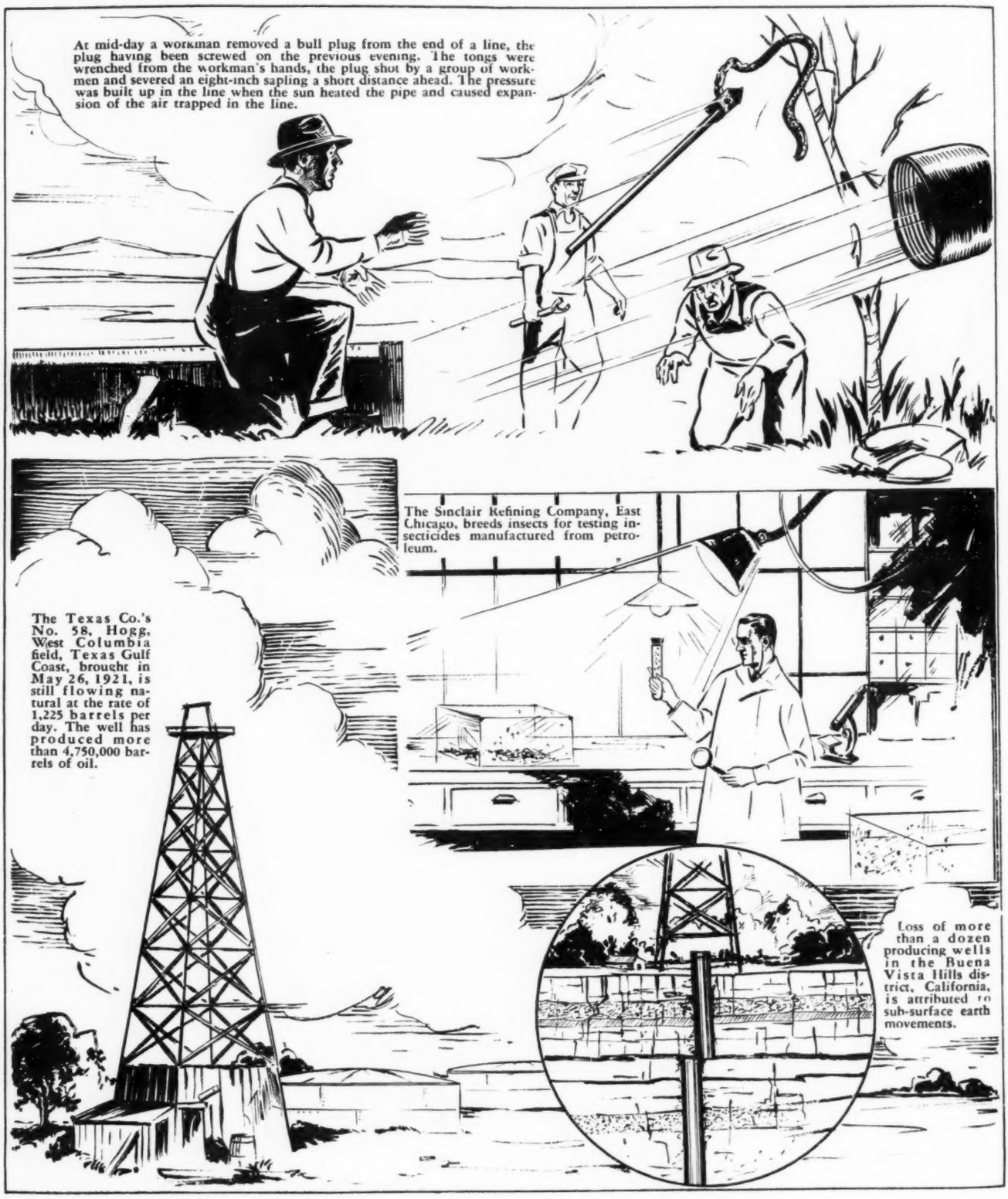
STRANGE... *but* TRUE

HAPPENINGS IN THE PETROLEUM INDUSTRY



At mid-day a workman removed a bull plug from the end of a line, the plug having been screwed on the previous evening. The tongs were wrenched from the workman's hands, the plug shot by a group of workmen and severed an eight-inch sapling a short distance ahead. The pressure was built up in the line when the sun heated the pipe and caused expansion of the air trapped in the line.

The Sinclair Refining Company, East Chicago, breeds insects for testing insecticides manufactured from petroleum.

The Texas Co.'s No. 58, Hogg, West Columbia field, Texas Gulf Coast, brought in May 26, 1921, is still flowing natural at the rate of 1,225 barrels per day. The well has produced more than 4,750,000 barrels of oil.

Loss of more than a dozen producing wells in the Buena Vista Hills district, California, is attributed to sub-surface earth movements.

International Harvester Trucks and Tractors are Laying the Iraq Pipe Line . . .

A 1200-mile oil transportation line running westward from Kirkuk, near the Persian border, to Haifa and Tripoli on the Mediterranean Sea.

Above: *McCormick-Deering-powered pipe-laying tractors string the pipe along a right-of-way and then make quick work of putting the line into the trench. Special equipment makes it possible to backfill the trench with the same outfit.*

At Left: *An International Model A-8 at work about 80 miles from Haifa, in typical Iraq pipe line country. The atmospheric temperature was 125 degrees (F.), yet the A-8 engine ran at normal temperatures on the entire trip.*

INTERNATIONAL Trucks have been closely identified with the construction of the Iraq Petroleum Company's pipe line since the inception of this vast project. They were called into the work early because of their success in many mammoth construction projects in other parts of the world.

Subjected to every possible test on the job, these Iraq Internationals have lived up to their reputation; as a direct result, more and more Internationals are going into Iraq service. Today, the major share of the transportation of pipe on this job is being entrusted to International Trucks.

In the Iraq project, termed the largest open country construction job in the world today, truck transportation is being given its most severe test. International Harvester is proud that International Trucks are worthy to be chosen for such an important share of this difficult job.

The full line of International Trucks is ready to serve you, economically. Sizes range from ¾-ton to 7½-ton.

McCORMICK-DEERING-powered pipe-laying tractors—so familiar a sight along every major American pipe line right-of-way—have been selected for much of the pipe-handling work along the Iraq line. These compact, powerful units, with their wide crawler tracks and other special equipment, take up the work where the International Trucks leave off. It is their task to work day-in and day-out under the broiling desert sun, lifting, hauling, and laying the big sections of heavy pipe.

Scores of these McCormick-Deering-powered units are ready for work in Iraq, where they will be guarded in their daily operation by the same dependable service for which International Harvester is well known everywhere.

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OF AMERICA
(Incorporated)
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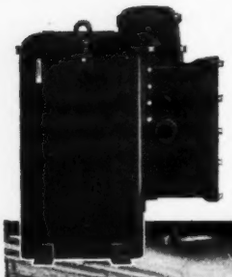
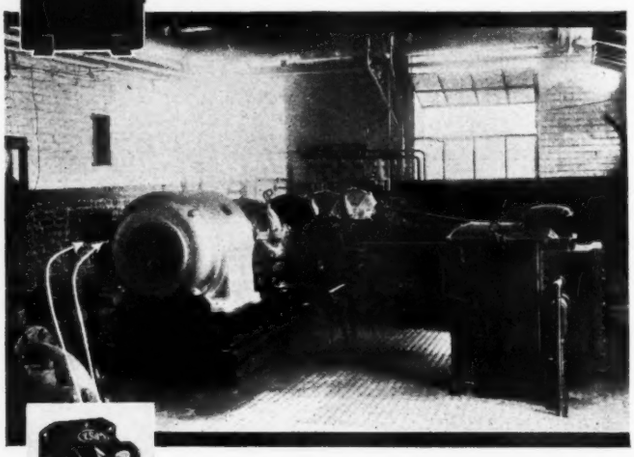


125HP EC&M Explosion-proof Motor Starter



and EC&M Explosion-proof Type EO Push Buttons

This motor-driven centrifugal pump, located in a large mid Western refinery, is of the multiple type and handles four different kinds of highly volatile liquids. An exact duplicate installation and several similar drives also present extremely hazardous conditions.

Consequently, EC & M Oil-immersed Explosion-proof Motor Starters and Type EO Push Buttons were selected by this plant to insure 100% safe operation.

In addition to being built in accordance with the Underwriters' specifications, EC & M Explosion-proof Control Equipment assures long periods of operation without requiring "opening up." Oil-immersion protects against moisture, sweating and corrosion. Write for complete information.

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FOR LOW VOLTAGE PROTECTION APPLICATIONS
Momentary Style
A.C. With or Without Oil

Form "A"

Form "B"

Form "C"

Volts	110/220	440	550	125	250	600	125	250	600
				D.C. Without Oil			D.C. With Oil		
Inductive Circuits—Amps.	30	25	20	2.25	.67	.20	15	7.5	3
Non-Inductive Circuits—Amps.	30	25	20	3.5	1	.30	20	10	4

FOR LOW VOLTAGE RELEASE APPLICATIONS
Maintained Style for Pumps, Lights, etc.

Form "E"

	A.C. With or Without Oil			D.C. Without Oil			D.C. With Oil		
Inductive Circuits—Amps.	30	25	20	5	1.5	.5	20	10	4
Non-Inductive Circuits—Amps.	30	25	20	7	2	.7	30	15	6

Write for Push Button Bulletin 1105

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Survey of Cracking Plants

THE United States Bureau of Mines Information Circular 6648, by G. R. Hopkins, economic analyst, states that the daily charging capacity of the cracking plants in the United States as of January 1, 1932, amounted to the record total of 2,046,981 barrels. This represents an increase over the previous year of 96,200 barrels, or five per cent. Although the increase in total charging capacity of the cracking plants during 1931 was considerably less than in 1930, it was about three times the increase in the capacity for straight distillation.

The total daily charging capacity of the plants operating on January 1, 1932, amounted to 1,603,809, or 78 per cent of the total; the capacity of plants under construction was 48,587 barrels, or three per cent. Compared with a year ago, these data represent a small increase in operative capacity, a large gain in inoperative capacity, and a large decrease in the capacity under construction. The refinery survey showed a comparable increase in the inoperative capacity of the equipment used for straight distillation, but showed a decrease in operative capacity and a much larger relative decline in the capacity under construction. These facts indicate an expansion in cracking at the expense of skimming.

In cracking, as in practically all industrial operations, capacity may be increased either by constructing new units or by remodeling existing equipment. Until five years ago most of the capacity that was added consisted of new equipment, but the last few years have witnessed a tendency to increase the potential throughput by modernizing existing units. It is estimated that at least 125,000 barrels of daily cracking capacity was added through remodeling in 1931, compared to about 150,000 barrels added through the construction of new equipment. On the other hand, the cracking capacity is also reduced in two ways, by the dismantling of old units and through obsolescence. It is estimated that about 110,000 barrels of capacity was dismantled in 1931 and that about 70,000 barrels was lost through obsolescence.

The number of cracking units as of January 1, 1932, totaled 1348, compared with 1868 a year ago. This material decline results chiefly from the dismantling of a large number of stills of small average capacity. The number of units has shown a steady decrease in recent years, the total capacity a steady increase. This trend is indicative of the tendency of refiners to replace small, obsolete units by one or two large modern units. For example, the average size of the cracking units on June 1, 1925, the date of the first cracking survey, was 330 barrels; on January 1, 1932, it was approximately 1,500 barrels.

Texas continued to rank far ahead of the other states in total capacity of cracking plants; California was second, Indiana third. The total capacity of the cracking plants in Texas, which are largely concentrated on the Gulf Coast, amounted to 645,720 barrels, or 32 per cent of the total for the United States. In a number of states the capacity of the plants dismantled in 1931 exceeded the increase, due to new construction or to the remodeling of old units. Wyoming showed the largest decrease in capacity during 1931; Oklahoma showed a decline for the second successive year.

Thirty-seven different types of cracking processes were reported in this survey compared with thirty-five years ago, and with twenty-seven in 1925. Approximately half of the num-

ber of types listed in 1925 were reported in the 1932 survey, from which it may be assumed that about two dozen new types have been developed in the intervening seven years. The number of processes showed the most rapid increase in 1928; since then the number of new processes developed has about equaled the number no longer reported. The various types of cracking processes may be divided into two general classes, one comprising those which have been actively licensed, the other made up of those that have been used exclusively by the respective companies which designed them. At the time of the first survey (1925) the license group was of primary importance, but the last few years have witnessed a rapid increase in the capacity of the "owner" group. For example, between January 1, 1931, and January 1, 1932, the total capacity of the "owner" group rose from about 930,000 barrels to 1,060,000 barrels; the total capacity of the license group declined from about 1,020,000 barrels to 990,000 barrels in the same period.

Cracking processes may be further divided into those which operate in the liquid phase and those which operate in the vapor phase. Liquid-phase processes were the first to be developed. The total capacity of the vapor-phase units practically doubled between January 1, 1930, and January 1, 1932. However, the total capacity as of January 1, 1932, is only about three per cent of the total.

The production of gasoline by cracking has shown a steady increase in recent years; in 1931, the output of cracked gasoline totaled 176,181,000 barrels, an increase of seven per cent over 1930. As the output of all grades of gasoline at refineries showed a small decrease in 1931, it follows that the proportion of cracked gasoline to the total increased materially. It might be assumed that, in times of low crude prices such as prevailed in 1931, the skimming of crude oil would be preferable to cracking. Actually the reverse held true; that is, cracking increased materially and skimming declined. At some refineries all the skimming units were shut down for months at a time and only the cracking plants operated. In some cases this was due to a restriction in the supply of crude oil, but in general it was a tribute to the increased efficiency of cracking plants.

In 1925 the average gasoline yield reported by all the companies was 33 per cent of the charging stock. In 1931 an analysis of the reports of about 25 large companies showed a yield of 45 per cent, indicating a material improvement in efficiency.

Statement of the Ownership, Management, Etc., of
THE PETROLEUM ENGINEER
October 1, 1932

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W. T. BRYAN, Secretary-Treasurer.

Sworn to and subscribed before me this 30th day of September, 1932.

ELLA DALY, Notary Public.
(My commission expires June, 1933).

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THE CRACKING ART IN 1930-1931 is the title of a book by Gustav Egloff, Badona L. Levinson and Margaret Herrman. Copies of this booklet, called U O P Booklet No. 107, may be obtained from the Universal Oil Products Company, 310 South Michigan Avenue, Chicago. The book is a report covering patents issued from November 1, 1929, to November 1, 1931. The report shows that the art of cracking has advanced since the survey made in 1928-29, accelerating during 1930 and 1931 in efficiency and flexibility as well as expanding greatly in volume.

THE PROPERTIES AND COMPARATIVE ANALYSIS OF SUCKER RODS is the subject of a pamphlet being distributed by The S. M. Jones Company, Toledo, Ohio. The book states that a thorough study of sucker rod breakage reveals practically all breaks are of what is known as the "progressive" or "fatigue" type, and that metals have a property known as the fatigue or endurance limit, which is a measure of the rod's ability to indefinitely withstand stress of a reversing nature below a certain maximum.

INSA-LUTE CEMENT AND COMPOUNDS CATALOGUE NO. 32, containing instructive information on industrial assembling, insulating, acid-proofing, etc., has been issued by Technical Products Company, Pittsburgh, Pa.

ARC WELDING SUPPLIES, by The Lincoln Electric Company, Cleveland, Ohio, is a new catalogue carrying the company's entire welding equipment, together with the latest price sheets.

WHO'S WHO IN VENEZUELA, 1932 (Second) Edition, compiled by C. C. McDermond, Apartado 331, Maracaibo, Venezuela, will shortly be ready for distribution. It is a reference book containing statistics of oil companies operating in the country, company personnel and a list of government officials, as well as banking, hotel, travel and shipping facilities. The book is prepared especially for the use of executives, operating officials, purchasing agents, importers, exporters and manufacturers of oil well equipment.

HIGH SPEED GEAR UNITS are discussed in Bulletin No. 425, recently published by the Farrel-Birmingham Company, 415 Vulcan Street, Buffalo, N. Y. The gear units are especially adapted for connecting Diesel or gas engines to high speed centrifugal pumps and similar service and are suitable for increasing speed of driven unit as well as reducing speed.

A NEW SMALL TOOL CATALOGUE, NO. 32, is just being distributed by the Greenfield Tap and Die Corporation, Greenfield, Mass. The entire line of taps, dies, screw plates, twist drills, reamers, gages, pipe tools and miscellaneous items of this company are completely listed and described.

Quite a number of new items have been added to the "Greenfield" line and are shown in this catalog for the first time. Prominent among these are "Tru-Lede" taps; "Lightning" twist drills; and an enlarged and improved reamer line, which includes expansion chucking reamers with both Morse taper and straight shanks, spiral fluted shell reamers, and a number of special automotive reamers.

"Little Giant" screw extractors, recently announced, are also listed for the first time. Other entirely new items are

the "OK" ratchet stock for square pipe dies, a line of Saunders type pipe cutters with thin edge chrome-vanadium cadmium plated cutter wheels; a new ratchet stock with "slip-on" re-threading dies; and a ratchet burring reamer.

Users of fine hand tools will also be interested in a new de luxe screw plate, the "Greenfield" chaser die screw plate.

There are also a number of valuable tables, and considerable new data on the uses and application of small tools.

Of particular interest is the new easy reference index, which makes the location of any subject in the 384 pages a simple and instant matter. The attractiveness of the catalog is greatly enhanced by its being printed throughout in color. Users of "Greenfield" tools who have not already received this catalogue can obtain copies from the manufacturers or their distributors.

THE AMERICAN METER COMPANY, New York City, announces the publication of Bulletin E-5 covering Metric Control for flow of gases and liquids and describing an important new development made possible by the Metric Rotary Pilot Valve.

The principal new features are an automatically adjusted opening for release of pressure from the diaphragm head which greatly reduces the amount of gas used for control; the elimination of tank and outlet throttle valve control, and a simplicity which assists in adjusting and cleaning.

Changes in the time element can be made by adjustment of a single micrometer screw and the unit can be used either with an open or closed type controlled valve by a single adjustment.

THE READING-PRATT & CADY COMPANY, INC., Bridgeport, Connecticut, has just issued a new eight-page catalogue, describing their bar stock valves. This line of Pratt & Cady Valves is precision turned from high grade bar stock metal, and is recommended wherever a high strength close control and low-cost valve is desirable. The valves are made in globe, angle and cross patterns of bronze, carbon steel and stainless steel. In addition there is a special Thru-Port Valve, and a "Roto-Control" Valve for range oil burners. Users of small valves will find the catalog very helpful, and can obtain a copy by writing direct to the company.

FOUR TO SIX PER CENT CHROMIUM STEEL TUBES AND PIPE is the title of a new 16-page bulletin issued by The Babcock & Wilcox Tube Company.

This publication presents, in technical style, the advantages of four to six per cent chromium steel tubes and pipe for refinery and other services. Recommended uses are prescribed, and complete chemical and physical characteristics given in detail. Data are also given on four to six per cent chromium steel with tungsten and molybdenum.

Refinery and process engineers and operators may secure copies of this bulletin by addressing The Babcock & Wilcox Tube Company, Beaver Falls, Pa.

NO SCALE, NO SLUDGE, NO MUD—The Application of Zeolite Water Softeners to the Treatment of Boiler Feed Water is the title of a very complete, interesting 36-page booklet just published by The Permutit Company, 440 Fourth Avenue, New York. It is profusely illustrated with photographs and diagrams and contains tabulated data, conversion tables, factors, reactions, etc. Copies may be obtained free upon request to the above company.

AIR-COOLED TRANSFORMERS is the subject of a new loose-leaf bulletin sheet issued by the Wagner Electric Corporation, 6408 Plymouth Avenue, St. Louis, Mo. It describes Wagner types AC and AA units in sizes 1 to 50 Kv-a., voltages 100 to 600—and also discusses their application. Part 4B of Bulletin 172 will be sent by the company on request.

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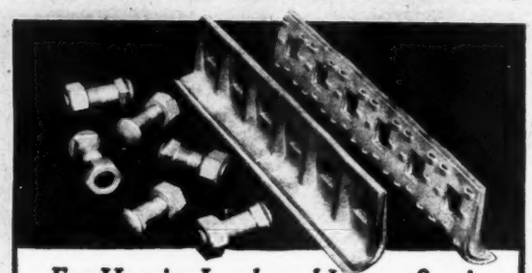

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By CHARLES H. KOPP,
Oklahoma City.

THE advent of so many different types of greases and the attempt of the compounding and blending plants to make the dealer and public grease-conscious has brought the necessity for simplification. This was probably suggested by general demand for economy and the resultant simplification of materials.

The desire for an all-purpose grease has resulted in the marketing of a product variously known as lucid compound. This compound is an aluminum soap emulsified with a medium motor oil. As such, its use in automobile differentials and transmissions is impossible. The use of lucid lubes in free wheeling units is not satisfactory, or in any place where it can be subjected to any considerable amount of moisture, since aluminum soaps, as is generally known, are easily decomposed by water vapor, forming an emulsified material much resembling mayonnaise in appearance.

Lucid lubricants are characterized by their extreme stringiness, adhesiveness and limpidness. They are, as can be gathered from the name, clear compounds resembling transpartent greases but having the bloom and opacity of the heavier lubricating oils which are used in their manufacture. For this reason, they are better lubricants than the general run of transparent greases usually made with 100 vis. paraffin.

The so-called "string" is defined as the tendency of the solid lubricant to stretch into a long, thin mass resembling a string. The adhesiveness is evidenced by the tenacity with which these lucid compounds stick to any surface. Its so-called "limpidness" is seen in the fact that these lucid lubricants will move in a manner similar to a lube oil, nearing its pour point when a can containing the product is tilted. All three of these characteristics in addition to clean appearance are, from a sales standpoint, inherent characteristics of aluminum greases, especially aluminum oleate.

The stringiness of lucid compounds can be secured either by the addition of aluminum oleate in sufficient quantity or by the addition of 100 vis. at 100 degrees Fahrenheit paraffin containing dissolved rubber. The latter method introduces a substance to which much objection can be raised, as rubber is not a lubricant, although aluminum oleate can be hardly considered as such either. Another objection is the necessity of dissolving the rubber which can only be accomplished under carefully controlled conditions. These conditions are the setting aside of the drums containing the necessary quantities of crepe rubber and 100 vis. paraffin in a warm place (about 100 degrees to 140 degrees Fahrenheit) with occasional stirring to keep the mixture in intimate contact. The adhesiveness is usually achieved along with the stringiness and, in the same manner, either aluminum oleate or rubber solution.

The "limpidness" is acquired by the control of conditions of the grease's manufacture. It is now well established that aluminum soap greases must be manufactured under care-

Lucid Compounds

Chemical Engineer
Oklahoma

fully controlled cooling conditions. This is usually accomplished by drawing off the grease into rectangular shallow pans, eight inches deep, and placing these pans in a room kept at approximately 70 to 80 degrees Fahrenheit temperature. This cooling rate necessitates cooling the room in summer and heating it in winter. Another important control of limpidness is the amount of aluminum soap used in the manufacture.

The formulae for the two methods of manufacture of lucid compound is:

I. Rubber

Al Stearate	70 lb.	5.8%
750 vis motor oil	1,083 lb.	89.8%
5% rubber solution	50 lb.	4.0%
Stearic acid	6 lb.	0.5%

II. Al Oleate

Al Stearate	5.0%
Al Oleate	3.0%
750 vis motor oil	92.0%

Method I.—The aluminum stearate must be thoroughly mixed in the cold with the motor oil. Usual practice is, after adding one-quarter of the weight of the oil to the kettle, to add all the aluminum stearate and stir the mix thoroughly. When the aluminum stearate is intimately mixed, the remainder of the oil is poured in, stirring continuing all the while and the mix heated gradually, heated to 300 degrees Fahrenheit while stirring. The mix was allowed to cool to 230 degrees Fahrenheit in the kettle, the rubber solution added and the grease drawn off into shallow pans 8 feet by 4 feet by 8 feet, and placed in the 75 degrees Fahrenheit room to cool. The so-called "sett" will usually take place at from 200 to 160 degrees Fahrenheit.

Method II.—The aluminum stearate is mixed into the grease in the same manner as in Method I. After all the oil has been added, the aluminum oleate pulp, containing about 20 per cent aluminum oleate, is thoroughly stirred in. The mix is heated gradually as before to 300 degrees Fahrenheit and drawn off and cooled as in Method I.

Several patents on the manufacture of aluminum oleate exist. The usual procedure is to make a sodium oleate soap By double decomposition with aluminum sulphate under a temperature of 325 degrees Fahrenheit and subsequent washing out of the sodium sulphate with water, the aluminum oleate is formed and is dissolved immediately in a 100 vis. neutral. This solution is usually aided by the fact that, at the start of the process, equal quantities of neutral and oleic acid are used. The oil present makes the washing-out process a ticklish one, due to foaming and the easy decomposition of aluminum soaps by water vapor under heat.

The final result of both processes, lucid compound finds a ready market due to its smooth, clear appearance. However, the usual objection to aluminum soap greases—easy decomposition by water vapor—limits its widespread application.

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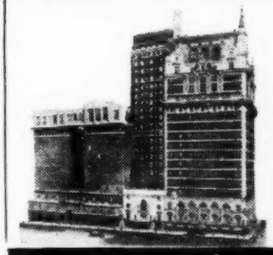

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Plain butt joint used without backing up ring on eight-inch line in East Texas field. Note use of removable backing up jig.

What We Have Learned After Almost Two Million Pipe Line Joints

By J. F. LINCOLN☆

ARC Welding was first used on petroleum transmission lines about five years ago. Since that time over 5000 miles of oil and gas transmission lines, ranging in size from six to twenty-six inches in diameter, have been put down welded by our equipment alone, to say nothing of the lines which have been arc welded with other machines and electrodes.

We have seen the first efforts to use the arc meet with almost insurmountable difficulties in the form of cost, time, and labor to the present day when a joint on 26-inch pipe with two beads can be made in seventeen minutes, including the scaling and cleaning of the bead.

Two major evolutions in the past five years have caused the improved speed and economy. The first is the development of portable gasoline engine driven equipment specially designed to meet the demands of hard usage in the field, and the innovation of the shielded arc process.

Today the pipe line contractor is able to use a 400-ampere welder with a current range of 120 to 500 amperes. This equipment, driven by a gas engine, is equipped with an automatic idling device which saves between 25 and 35 per cent in fuel. Mounted on wheels it can be easily towed by truck or tractor where it is needed.

The pipe line engineer is able to specify joints of over 65,000 pounds per square inch tensile strength, and have hundreds of field coupons average over 70,000 pounds. Ductility, extremely important in pipe lines, is very high.

The first arc welded pipe line was a seven-inch line for the transportation of gas from Lamkin to Hodge, Louisiana. This was completed in December, 1927, and bell and spigot joint pipe was used.

This was the first type of joint generally used. Two beads, a stringer and a finish bead, were run while the pipe was turned by a helper. Only the best operators were able to weld with the speed necessary to keep the process profitable, for although the cost of equipment and electrode was low, the time factor was all-important and the time on a joint on 16-inch pipe ran as high as 90 minutes.

When the 824-mile Texas-Empire line was laid the 46,728 bell and spigot joints were arc welded. By this time pipe line contractors were using a welding dam on this type of joint. The additional cost of this dam was more than offset by the increased speed of welding. Under favorable weather conditions the number of points per man in the 12-inch pipe used on the Texas-Empire line averaged 25 a day.

The introduction of the shielded arc employing a heavily coated electrode started the great boom of arc welding on pipe lines.

The type of joint used was the double bell with a backing up ring. The bell type of joint was specified to preserve a constant inner diameter of the pipe, offering no obstruction to the flow of oil. On gas lines this is unnecessary and the plain end pipe with backing up ring is used.

One of the most recent developments on oil lines is a plain butt joint without a backing up ring. This is an eight-inch line which was woven through the maze of pipe in the East Texas field. The line is nine miles long and was completed in seven days. It was welded by the shielded arc process.

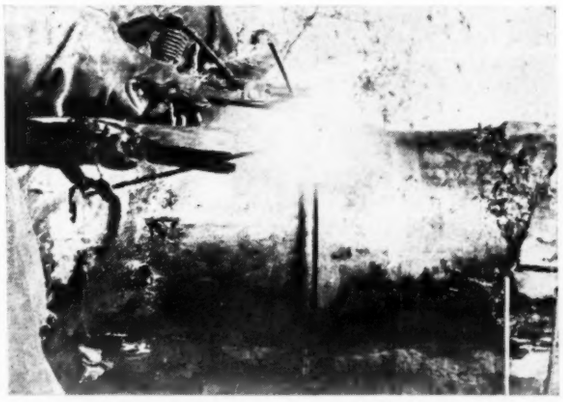
After the pipe is lined up with a backing up jig and tacked, the jig is removed. For bell hole welding the backing up jig is replaced by a special clamp devised to line up the sections

☆President, The Lincoln Electric Company, Cleveland, Ohio.

for tacking. This clamp consists of two pieces of pipe hinged to fit over the line. Boomer hooks and chains provide proper leverage. The clamp is pierced by slots to permit tack welding. The pipe sections are brought as close together as possible, fitted into the clamp and the "free" section pushed into contact with the other, lined up and then tack welded.

The standard procedure which has been evolved for pipe line welding with the shielded arc was, on the record-breaking Kettleman Hills line, about as follows:

The pipe was lined up in sections and the tacking crew followed closely behind the line-up gang. The backing up ring was first inserted into the stationary section and tacked. The next section was then fitted over the section and tacked in three places. Tack welds were made with one-fourth-inch shielded arc electrodes and the welds were about one and one-half inches long. The pipe is, of course, lined up on rollers.



Bell and Spigot Joint with welding dam used on early arc welded petroleum lines

The usual firing line gang consists of anywhere from three to nine units, depending usually upon the diameter of the pipe, and each unit is composed of a welder operator, two helpers and welding equipment. The equipment is moved by tractors.

One of the helpers turns the pipe, while the other stands by to clean the bead. The operator signals with his head for the speed of turning, and all he must do is hold the proper arc.

Pipe of either 30-degree or 40-degree bevel is used and the electrode size of 5/16-inch and 3/8-inch. Eighteen-inch length electrode is most widely used for pipe line welding.

After the first bead is run, the operator moves to the next joint and his helper cleans the bead while the pipe is turned again. It is customary to complete the first bead in each joint of a section before starting the finish bead. The terrain determines the number of lengths to a section, although the aim is to use as many rolling welds as possible and eliminate bell hole welding, which requires overhead operation of the electrode.

Following the firing line gang come the bell hole units. In many cases, particularly on large size pipe, two welders and one helper are used. This allows greater bell hole welding speed. The time for bell hole welds averaged, on the 26-inch Kettleman Hills line, 90 minutes for four beads. Welds are usually inspected visibly as they are made and on some lines air pressure is applied to each completed section. Coupons are cut from the joints and tested for tensile strength and ductility. In 3000 miles of lines done with the shielded arc process, the average tensile strength was close to 75,000 pounds per square inch. To be specific, on the 24-inch gas line extending from the Texas Panhandle to Chicago, 126 coupons showed an average tensile strength of 77,879 pounds per square inch. On another section of this line 148 coupons showed an average tensile strength of 76,580 pounds per square inch. The variation in tensile strength is caused by the carbon content of the pipe, as .25-.35 carbon pipe will give stronger connections than .20-.30 carbon pipe.

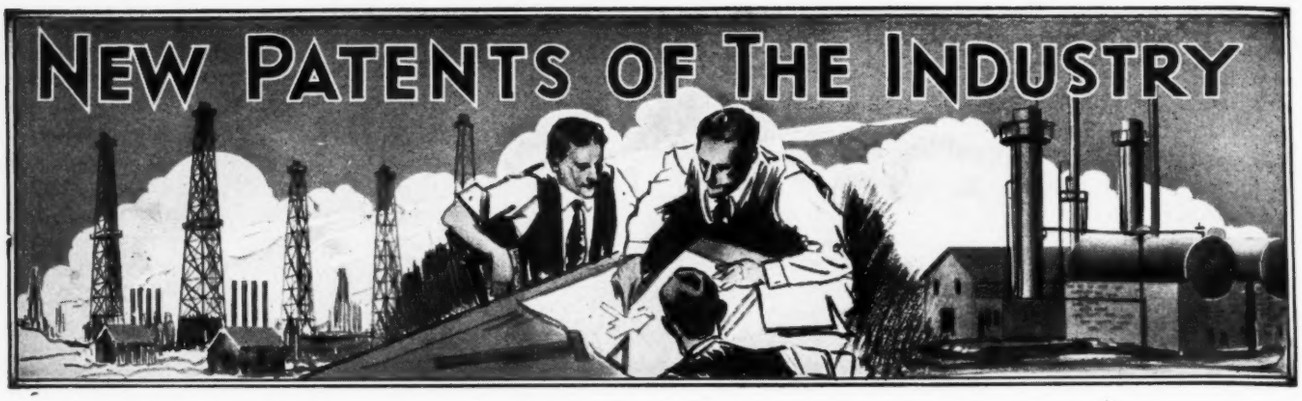
Ductility is tested in the field by bend tests on coupons cut from the arc welded joints. On one line the average bend in was 78 degrees. The average bend out was 96 degrees. On another line the average bend in was 97 degrees and the average bend out 129 degrees.

Most important in pipe line welding is the operator, providing, of course, that modern equipment is used. When the shielded arc process was first introduced there were only a few men who could use it on pipe lines, but in the last eighteen months numbers of skilled operators have been developed, and most of the pipe line contractors report no shortage of labor. A pipe line welder operator must be not only a good operator but must possess the physical strength to stand long hours at high speed in the open under all sorts of weather conditions.

An excellent example of what can be done with this process is seen in the record of H. C. Price, Inc., of Bartlesville, Oklahoma. In the last few months this company welded 180 miles of 10-inch line in 58 calendar days, 120 miles of 12-inch line in 40 calendar days and 124 miles of 26-inch line in 120 working days.

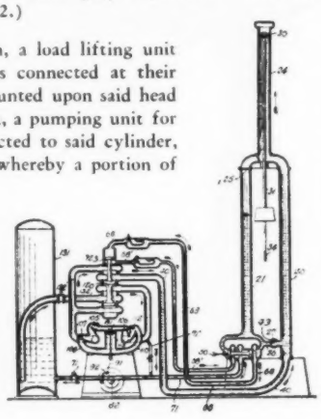
Two operators making bell hole weld on 26-inch gas line

NEW PATENTS OF THE INDUSTRY

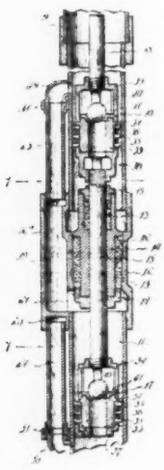


1,879,262. HYDRAULIC PUMPING SYSTEM. WILLIAM E. HUBBARD, Los Angeles, Calif., assignor to The Guiberson Corporation, Dallas, Texas, a Corporation of Delaware. Filed July 30, 1929. Serial No. 382,138. Eight claims. (Cl. 60—52.)

1. In a hydraulic pumping system, a load lifting unit comprising parallel pressure columns connected at their upper ends by a head, a cylinder mounted upon said head and communicating with one column, a pumping unit for supplying fluid to the column connected to said cylinder, a conduit connecting said columns, whereby a portion of the fluid supplied by said unit flows into the other column, a fluid system connected to said other column, a valve controlled by said system for affecting the operation of said pumping unit, and a working plunger disposed in said cylinder and having a rod depending parallel to said columns.



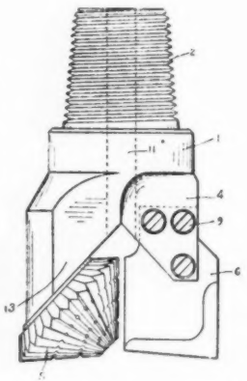
1,879,178. OIL WELL PUMP. ALFRED GEDDES, Buffalo, N. Y. Filed February 24, 1930. Serial No. 430,945. Two claims. (Cl. 103—184.)



1. A coupling for the pump barrels of a double piston oil well pump comprising a body portion having an integral extension at one side the length of the coupling, the body portion being provided centrally with a stuffing box and internally threaded at the ends of said body portion to receive the pump barrels, vertical and horizontal walls in the vertical extension at one side of the coupling forming by-passes communicating respectively with the opposite ends of the body portion of the coupling and with openings at the opposite ends of the extension, said openings being threaded to receive pipes connecting the coupling with the pump barrels.

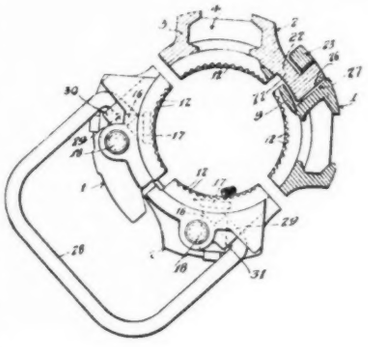
1,879,127. COMBINATION ROLLING AND SCRAPING CUTTER BIT. ROBT. W. SCHLUMPF, Houston, Texas, assignor to Hughes Tool Company, Houston, Tex., a Corporation of Texas. Filed July 21, 1930. Serial No. 469,301. Four claims. (Cl. 255—61.)

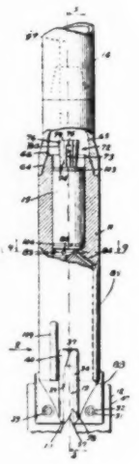
1. An earth boring drill, including a head, a pair of downwardly projecting arms thereon, an approximately frusto-conical rolling cutter mounted upon one of said arms, and a flattened scraping blade secured upon the other of said arms.



1,874,440. PIPE SLIP. JOHN CHARLES BUSH, Aliquippa, Pa., assignor to The National Supply Company, Toledo, Ohio, a Corporation of Ohio. Filed Dec. 2, 1930. Serial No. 499,512. 5 Claims. (Cl. 24—263.)

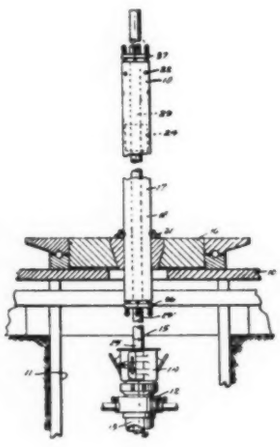
1. In a device of the class described, the combination of a pair of slip bodies, tongues projecting from the adjacent edges of said slip bodies, a pair of spaced engaging lugs projecting tranversely of the adjacent edge on one of said tongues, a pair of complementary spaced recesses formed in the tongue of the other said slip body to receive said lugs, and a slip liner secured to the latter said slip body in position to engage with the tongue of the first said slip body and hold the slip bodies from collapsing inwardly.





1,879,226. MAGAZINE TYPE OF DRILLING TOOL. EDWARD H. HEDDY, Fillmore, Calif. Filed June 26, 1929. Serial No. 373,772. Fourteen claims. (Cl. 255—61.)

5. A drilling appliance comprising a drilling tool having a first set of cutters rigidly connected thereto, a second set of cutters shiftably mounted in the tool and means to press the second set of cutters laterally outwardly to bring said second set of cutters into operation on the bottom and side walls of the hole on dulling of the first set.

1,879,455. GRIFF STEM. BENJAMIN E. PARRISH, Cody, Wyoming, and WAYNE N. BLACK, Tuxpan, Mexico, assignors of one-half to J. H. Reynolds, Houston, Texas. Filed January 2, 1931. Serial No. 506,178. Six claims. (Cl. 255—23.)

1. In a grief stem, a rotary drive shaft having an angular exterior, means for mounting said shaft on a drill line, and means connected in the drill line for slidably engaging with the shaft throughout its length to impart rotation to said drill line.